AUGUST 1941—FORTY-SEVENTH YEAR

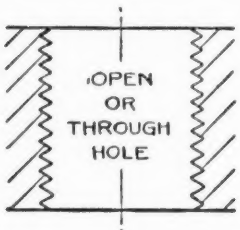
MACHINERY

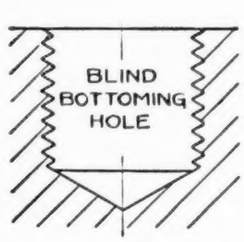
THE INDUSTRIAL PRESS Publishers, 140-148 LAFAYETTE ST., NEW YORK

Hole Hints FOR TAPPERS

SLOW production, rejected parts and broken taps, are often due to poor preparation of holes for tapping operations. Here are some points which will help you to prevent costly losses.

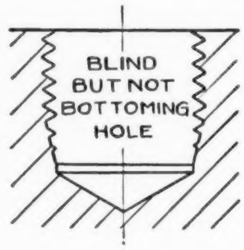
Always keep in mind that good clean drilling and a reasonable size maintenance are keys to better, faster tapping and with less strain on the tap and less power consumption.

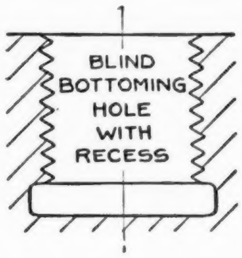




For open or "through" holes in steel, use "*Gun*" or Plug Taps; stick to Plug Taps for gray cast iron and non-malleables; for cast iron containing steel, use "*Gun*" Taps. For blind or bottoming holes, use a Bottoming Tap if the full length of the hole is to be threaded. Always be sure the drill chips are removed from the bottom of the blind hole before you start to tap.

A 100% thread depth requires 3 times the power necessary to tap a 75% thread, but is only 5% stronger. A nut





with 50% thread depth will break its bolt before the thread will strip. Good manufacturing practice should provide a depth of thread not less than 62% to 75% (depending on the size) and not more than 83⅓% of the basic thread depth. Remember these facts and you will not make your drilled holes too small.

The tougher and harder the material, or the deeper the tapped hole, the smaller the thread depth you can safely adopt.

Punched holes in thin sheet metal tend to cause taps to "load" and break. See that punched holes are not too small. Same with cored or forged holes in casting or forging. It pays to drill them.

As a guide to the most practicable drill size for all threads, consult any standard tap drill chart. We will gladly send you one on request.

This is one of a series of advertisements published by Greenfield Tap & Die Corporation to help users get greater production from their small tools in these critical times, through making useful facts more widely known

GREENFIELD TAP AND DIE CORPORATION • GREENFIELD, MASSACHUSETTS

DETROIT PLANT: 2102 West Fort St.
WAREHOUSES in New York, Chicago and Los Angeles
In Canada: GREENFIELD TAP AND DIE CORP. OF CANADA, LTD., GALT, ONT.

GTD REG. U.S. PAT. OFF. GREENFIELD

TAPS • DIES • GAGES • TWIST DRILLS • REAMERS • SCREW PLATES • PIPE TOOLS

DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

AUGUST, 1941

Work that formerly took weeks is now accomplished in a few minutes by means of processes developed by the Lockheed Aircraft Corporation. These processes will be the subject of the leading article in September MACHINERY. Other important articles will deal with "Suggested Improvements to Facilitate Thread Cutting" and "Munitions Cleaning."

Volume 47
Number 12

PRINCIPAL CONTENTS OF THIS NUMBER

For Complete Classified Contents, See Page 178

DEPARTMENTS

Product Index 260-280
Advertisers Index 283-284

TOTAL DISTRIBUTION
19,925

PUBLISHED MONTHLY BY
THE INDUSTRIAL PRESS
148 Lafayette Street New York

ROBERT B. LUCHARS .... *President*
EDGAR A. BECKER *Vice-pres. and Treasurer*
ERIK OBERG .... *Editor*
FRANKLIN D. JONES..... *Associate Editor*
CHARLES O. HERB....... *Associate Editor*
FREEMAN C. DUSTON.... *Associate Editor*

LONDON: MACHINERY, 83-113 Euston Road
PARIS: La Machine Moderne, 15 Rue Bleue

SUBSCRIPTION RATES: United States and Canada, one year, $3; two years, $5; three years, $6 (for Canada add 25 cents per year for war tax); foreign countries, $6 a year. Single copies, 35 cents. Changes in address must be received by the fifteenth of the month to be effective for the forthcoming issue. Send old as well as new address.

Entered as second-class mail matter, September, 1894, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in the United States of America. Member of A.B.P. Member of A.B.C.

MACHINERY

Volume 47 NEW YORK, AUGUST, 1941 Number 12

Spot-Welding Jigs Speed Up Aircraft Building

The Use of Work-Holding Jigs in Spot-Welding Operations Saves Much Time and, in Addition, Insures Interchangeability of Welded Products

By CHARLES O. HERB

PRESENT production schedules in the aircraft building industry have enabled many methods to be adopted that would not have been economical under smaller schedules of manufacture. As a consequence, production in factories from coast to coast has been speeded up greatly without any sacrifice in quality, and even, in many instances, with a considerable improvement in quality.

Operations in the welding department of the El Segundo, Calif., plant of the Douglas Aircraft Co., Inc., fall into this category. Jigs have been adopted for most of the spot-welding operations, with a subsequent reduction in welding time that ranges up to 50 per cent. Most of the time saved has resulted from eliminating the need for laying out work prior to welding, the parts to be welded together being properly located in the jigs with respect to each other. Also of prime importance is the fact that the use of these welding jigs provides complete interchangeability of the welded products.

Jigs have been adopted for the majority of the operations in this welding department, and the aim is to provide jigs for all operations that are performed on a large quantity basis. Some of the typical jig designs used are described in this article.

Fig. 1 shows a jig that is used in a spot-welding operation on an antenna mast. Two edges of a long folded sheet of duralumin are welded together. The spot-welds must be accurately located from the edges of the sheet, so as to avoid being cut into by

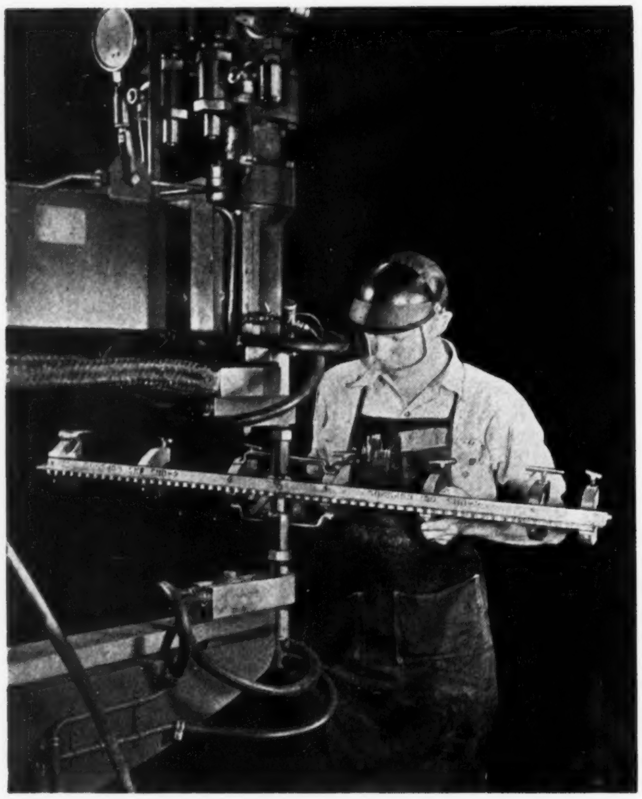


Fig. 1. Jig that Provides for the Accurate Location of Spot-welds along the Edges of an Antenna Mast

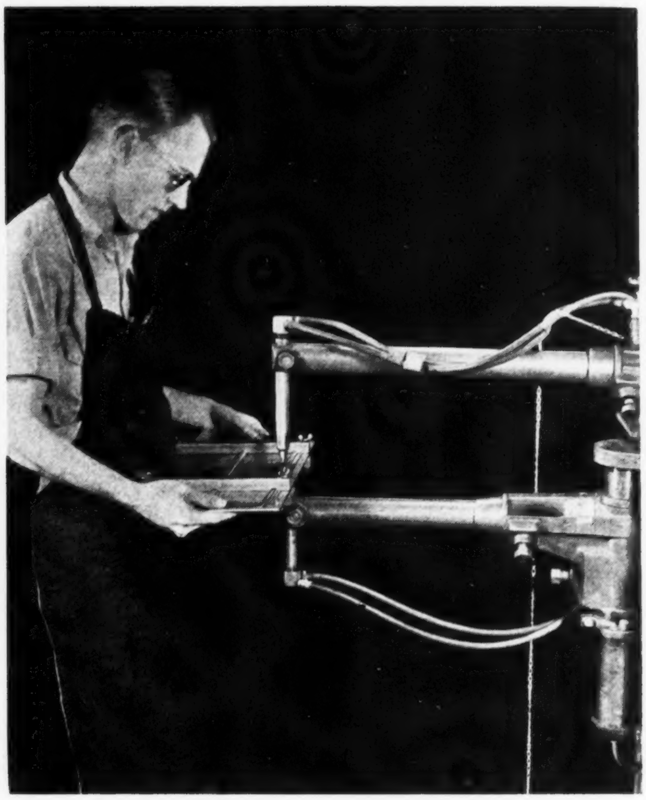


Fig. 2. Jig that Consists of a Copper Plate and Four Bars which Locate and Clamp Pieces to be Welded

the routing cutter that is used subsequently in machining the welded edges to a minimum dimension. It is also desirable to have the spot-welds fairly accurately located with respect to center distances.

The jig consists simply of two long aluminum bars to which are fitted the hinged members of seven clamps. These clamps are swung open to release the work and closed for clamping it. Adjustable screws are tightened to lock the clamping members on the work. One hinged member of each clamp is fastened to the top bar of the jig, and the other to the bottom bar.

The bottom bar serves also as a guide for accurately locating the jig for each step in the spot-welding operation. It is machined its full length, with half-round depressions spaced 3/4 inch apart. The bottom electrode of the Sciaky welding machine, on which the operation is performed, is fitted with a Bakelite bushing of the same radius as the depressions in the jig bar. Location of the jig for the welding steps is accomplished by merely registering the depressions of the bottom bar successively against the Bakelite bushing.

Before this jig was designed and the distance between the welds was left to the judgment of the operator, the center-to-center distances varied from 1/2 inch to 1 1/4 inches. Also, many welds were made too close to the edges of the work to provide sufficient stock for the routing operation. The bushing used for locating purposes is made of Bakelite so as to prevent electrical current from being passed through the jig members by the bottom electrode. The jig members are also insulated against electrical current in a number of places by the application of strips of Scotch tape.

Some of the jigs are of extremely simple design as, for example, the jig shown in Fig. 2, which is used in welding two stainless-steel stiffeners to a rectangular sheet of stainless steel. This jig consists merely of a copper plate, slightly longer and wider than the sheet of stainless steel. Dowel-pins are provided on the copper plate to locate the stainless-steel sheet both sidewise and lengthwise. Two clamping bars are fastened crosswise of the copper plate on both sides by means of screws and thumb-nuts to provide a means of holding the parts to be welded in their proper place on the jig.

Work is loaded on both sides of the copper plate, so that right- and left-hand pieces can be produced in one operation. The clamp bars are slotted for locating the stiffeners crosswise. In the welding operation, the current passes through the two pieces of stainless steel on one side of the copper plate, through the copper plate, and then through the two pieces of stainless steel on the other side to the second electrode of the welding machine.

A jig that is constructed entirely of copper is seen in use in Fig. 3. The pieces to be welded are clamped to the outside of the jig, the members of which provide a firm inside support under all surfaces to be welded. The copper jig members conduct the electrical current from the electrodes

through the sheets that are being welded on each side of the jig. In this instance, the part is merely tack-welded together, complete welding being performed afterward in a production set-up.

A jig designed to facilitate the progressive building up of bomb chutes is illustrated in Fig. 4. This jig is mounted on casters and connected to the welding machine by means of flexible leads in place of the lower electrode arm. This allows the assembly to be rolled in and out for tack-welding to jig dimensions. The top of the jig has slots which locate the vertical bulkheads of stainless steel. The horizontal partitions are located and tack-welded along each bulkhead flange. The assembly is first jig tack-welded in three sections which are later tack-weld assembled to each other in the same jig. This allows the major portion of the welding to be done on visible and easily accessible outside surfaces.

At the time that the photograph was taken, the operation had practically been completed. Guides on top of the jig provide a means of locating the jig with respect to the upper electrode for each line of tacking welds. Copper bars that extend under the sheets being welded serve as electrical conductors. Production welding is done later by means of a roll-welder at the rate of 6 lineal feet per minute.

At the left in Fig. 5 is shown an ammunition drawer that must be held absolutely to established dimensions for interchangeability. This drawer is welded together from seven sub-assemblies that are loaded into the jig seen at the right. The top of the jig, which is constructed from aluminum angles and flat strips, is removable to permit loading of sub-assemblies and unloading of the welded drawer. It is fastened to the bottom part by means of thumb-nuts. The sub-assemblies are merely tack-welded together while in the jig, complete welding being performed after removal of the assembly from the jig. The ammunition box is constructed entirely of stainless steel.

At the bottom of Fig. 6 is seen an assembly jig that is employed in welding the four sub-assemblies seen in the top row into the link ejection chute shown in the middle of the illustration. This chute is also constructed entirely of stainless steel. The individual pieces are jig-welded before they are placed in the assembly jig.

The assembly jig consists essentially of an aluminum base, equipped with three pairs of clamps for locking the various sub-assemblies in their proper locations. In the center of the jig is seen a long slender rod provided with three copper blocks which are inserted into the parts to be welded together. The rod is hinged at a distance of about 1 foot from the left-hand end to enable the block at this end to be passed through the portion of the chute that must be assembled at an angle with respect to the other two main sub-assemblies. In addition to the square copper blocks on this rod, there is a copper plate at the right-hand end of

Fig. 3. Simple Jig which is almost Completely Enclosed by the Sheets of Metal being Welded together

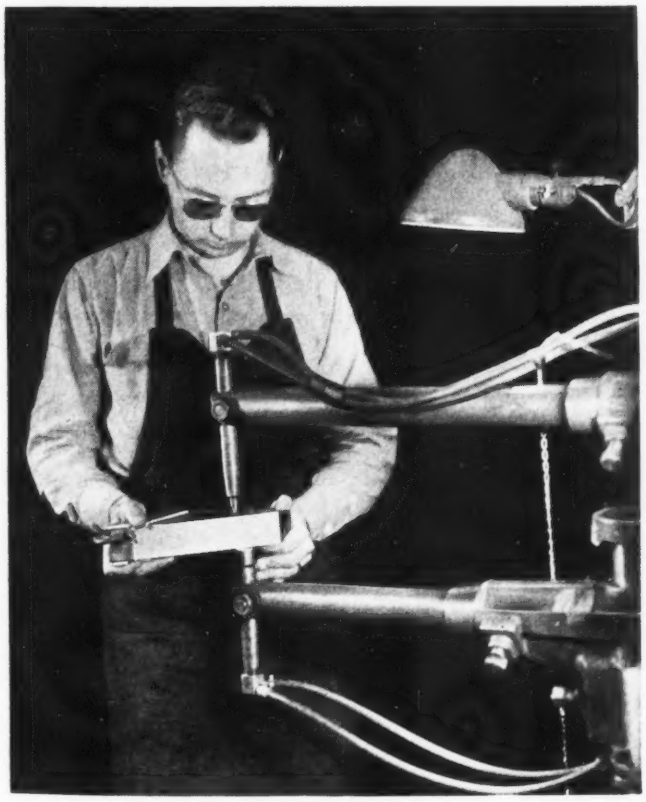


Fig. 4. Roller Type Jig which Makes Possible the Progressive Building up of Multiple Type Bomb Chutes

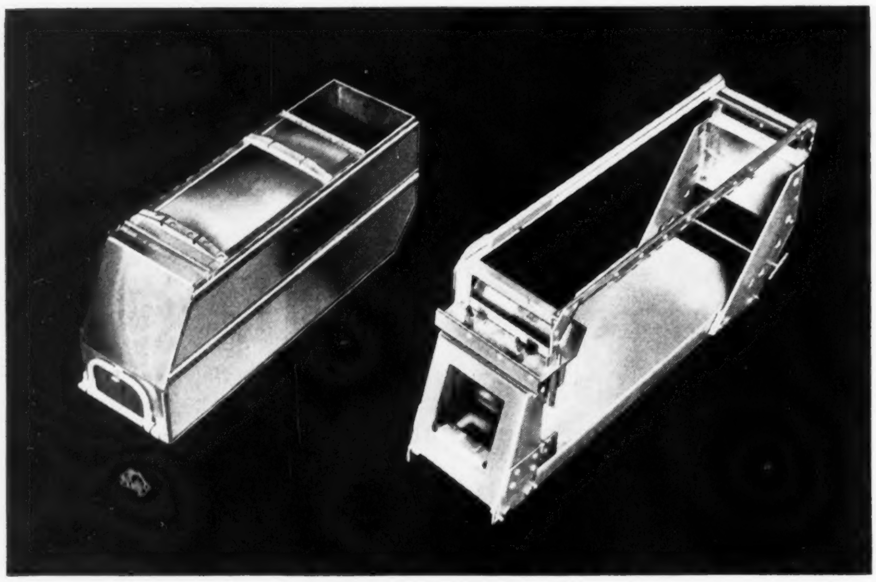


Fig. 5. (Left) Ammunition Drawer of Stainless Steel, and (Right) Jig that Insures Interchangeability of All Drawers of This Type

the base opposite the point where a spring cover is welded to the chute. The copper pieces contact completely around the inside of the chute along the surfaces to be spot-welded and serve as conductors for the electrical current.

Welding around all four sides of the chute is made possible by providing slots in the aluminum base below the copper blocks, thus enabling the electrodes of the welding machine to be applied on the bottom side of the jig. Before this jig was designed, it was virtually impossible to produce the four-foot long chute within the required straightness tolerance.

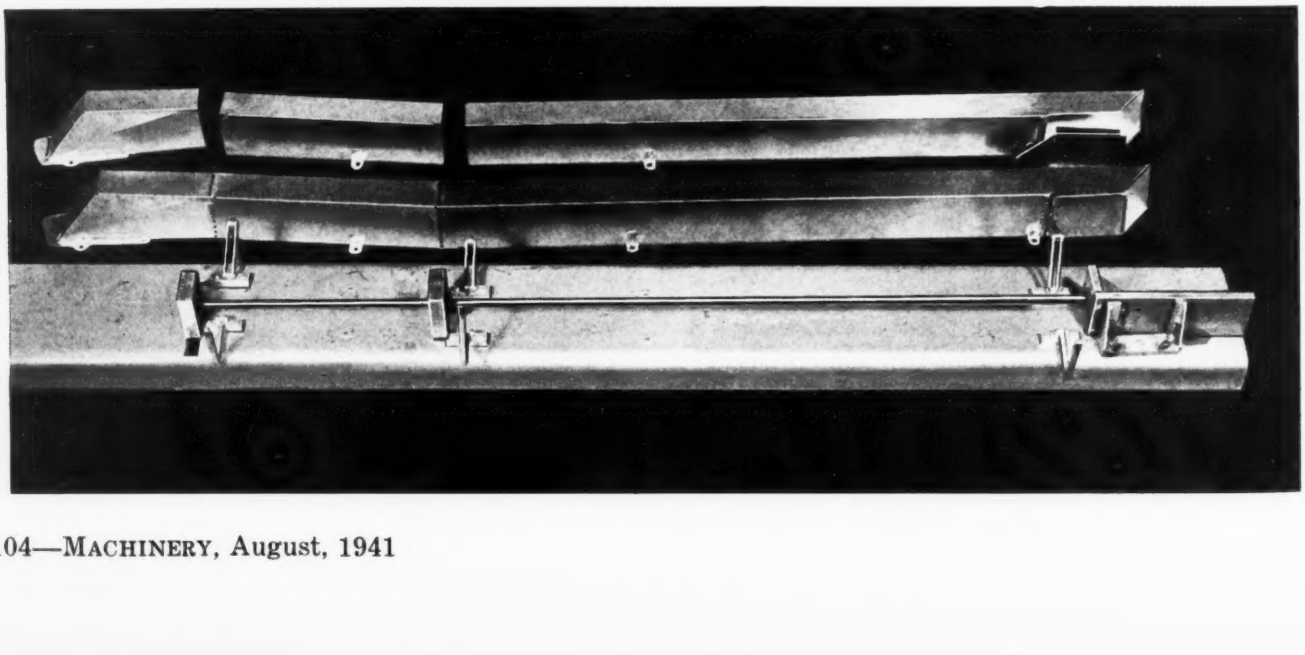
* * *

Approximately three-fourths of all the steel rails produced in the United States last year were of 100-pound section or heavier. Steel rails produced in 1940 amounted to 1,680,000 tons, an increase of 28 per cent over 1939. The 1940 output was the highest since 1930.

Trailers Expedite Deliveries of Materials

By an ingenious use of trailers attached to trucks, Fairbanks, Morse & Co. have greatly expedited the transportation of materials between their plants in Beloit, Wis., and Three Rivers, Mich. Briefly, the plan is as follows: A truck pulls a trailer loaded with castings from Beloit to Three Rivers, where the castings are machined. Upon arriving at Three Rivers, the trailer is immediately detached from the truck and the truck is attached to a second trailer which stands ready to return to Beloit, loaded with two five-ton engine frames. When the truck arrives in Beloit, this trailer is unhooked from the truck and a third trailer, which is already loaded with castings, is attached to the truck which is able to return immediately to Three Rivers. By the use of this system, the truck used in pulling the trailers is in service all the time, and there is no loss of time waiting for the loading or unloading of the trailers.

Fig. 6. Assembly Jig Designed for a Link Ejection Chute and, above it, Assembled and Unassembled Chutes



Carbide-Tipped Tools for Boring Operations

By GAYLORD G. THOMPSON, Tool Engineer
McKenna Metals Co., Rockford, Ill.

Developments in Standardizing Carbide Boring Tool Bits to Improve Cutting Action and Reduce Number of Sizes and Forms of Bits Required

THE design of carbide-tipped boring bits must be different from that of carbide-tipped turning tools. The diameter of the hole to be bored limits the diameter of the boring-bar and this, in turn, limits the degree of rugged support that can be given to the boring bit. A greater latitude in design and dimensional factors that provide strength is permissible in turning tools, but turning tools will not prove efficient for boring operations unless the grinding angles are changed.

The cutting angles of turning tools can be standardized, one style of tool, for example, being satisfactory for turning several different sizes of work, provided the nature of the job remains the same. This, however, is not true in the case of boring tools, where the size of the hole governs the tool angles; for example, the smaller the hole, the greater the positive back-rake angle required.

There are limits, however, to the extent that tool angles on boring bits can be changed to suit the requirements of a boring operation. The back-rake angle, for example, if progressively increased for use in boring holes of constantly diminishing size, would finally reach a point where the shank of the small tool bit would be practically cut in two. Furthermore, tool inventories would be exceedingly high if a different style of boring tool were carried in stock for each boring operation, particularly in plants where a large variety of work is handled.

To meet this problem, the McKenna Metals Co. has recently developed a type of carbide boring bit that has been adopted as a regular or standard design. This bit will serve efficiently on most steel boring operations, and still has fundamental design features that permit it to be adapted for special boring jobs with a minimum of regrinding. A 12-degree positive back-rake angle was selected as standard for this new style tool, since this angle, combined with a compound front clearance angle, will give the tip of the tool firm support and yet allow ample clearance for most boring jobs. If this tool does not exactly suit the requirements, it can be easily modified by grinding to obtain the slight change necessary in the rake angle.

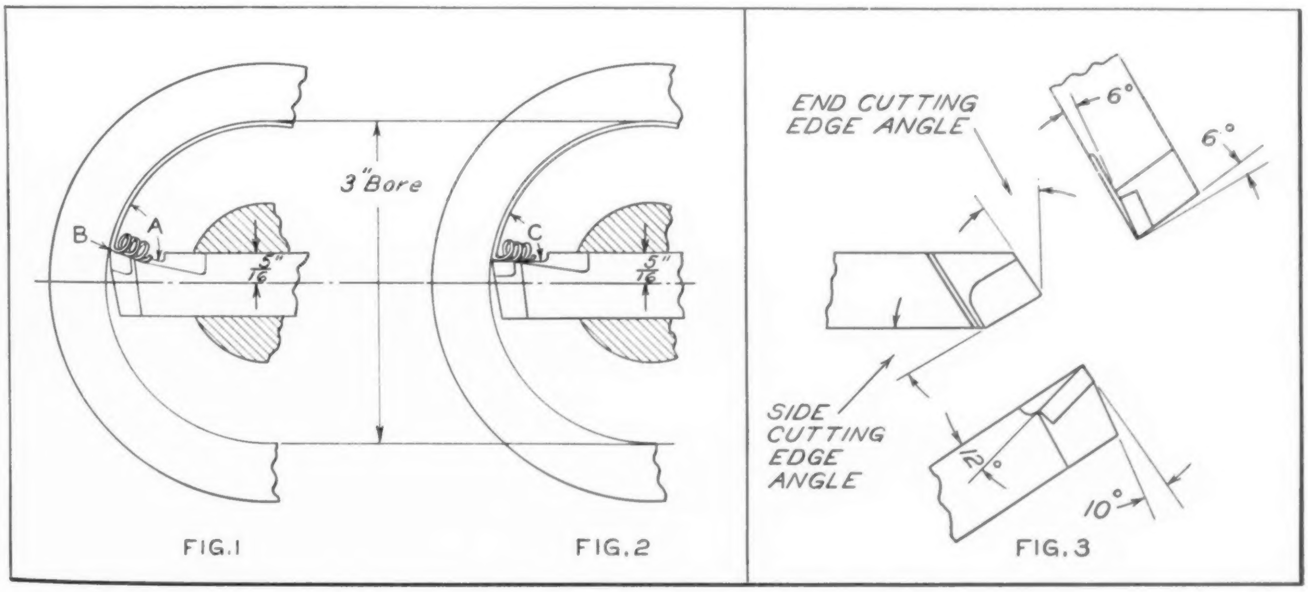


Fig. 1. Carbide-tipped Boring Bit Designed to Eliminate Excessive Negative Top Rake, as Shown by the Compromise Positive Back Rake at A, the Zero Front Clearance Angle Giving a Firm Support to Cutting Edge at B. Fig. 2. Regular Carbide Turning Bit as it Appears when Used for Boring. A 5/8-inch Boring Bit in a 2-inch Bar would be 5/16 Inch above Center, Creating a 16-degree Negative Top Rake C if Used in Boring a 3-inch Hole, which would be too much. Fig. 3. Boring Tool with 30-degree Side-clearance Edge Angle and 33-degree End-clearance Edge Angle—One of the Tools Adopted as Standard

The purpose of the 12-degree back rake on this tool is to compensate for the negative rake effect resulting from holding the tool radially at a height above the center equal to one-half the width of the shank. When the cutting edge is placed on center, the average hole can be bored with these tools, the effective back rake varying from minus 4 to plus 4 degrees, depending upon the diameter. The primary clearance on the tool is zero, which brings the tool to an effective cutting clearance angle of 4 to 10 degrees, as held for the average hole-boring operation. These angles may be modified to suit particular jobs by grinding them slightly to give a minus 2-degree effective back rake when in the boring position, and 4 to 6 degrees primary clearance. The secondary clearance of 10 degrees on the shank permits the tool to enter the holes without rubbing at the heel. On various small holes, the heel of the tool can be chamfered to provide ample clearance.

The manner in which this new style boring bit functions is shown in the front sectional view of a typical boring operation in Fig. 1. This view shows the firm support given the cutting edge of the carbide tip at *B* in contrast to the weak support of the cutting edge when a standard turning tool is used for boring, as shown in Fig. 2. In the latter case, the point of the tool is likely to break off.

While the back rake and clearance angles have been adopted as standard for the new boring bit, side-cutting edge angles and end-cutting edge angles vary for the six standard styles in which the tool is now supplied. A Style 27 boring tool, with a 30-degree side-cutting edge angle and a 33-degree end-cutting edge angle, is illustrated in Fig. 3.

The various combinations of edge-cutting angles will be found effective for most boring jobs where bits are held in the boring-bars at angles of from 45 to 90 degrees—both for boring straight through and for cutting up to a 90-degree shoulder, as indicated in Figs. 4 to 7, inclusive. The right- and left-hand tools for the six styles of boring bits adopted as standard have been designated Styles 23 to 34, inclusive. These tips permit high cutting speeds on steel up to 550 Brinell hardness, close tolerances, greatly reduced tool wear, and an absence of cratering from steel chips.

Because of the firm support given to the cutting edge, the newly designed carbide-tipped boring tool will eliminate the greatest cause of high tool mortality in boring operations — namely, insufficient support for the carbide tip. This is particularly important during the present period of increased production, when most plants can ill afford to stop their machines to replace broken tools.

* * *

Increased Production of Machine Tools

As an example of the increase in machine tool production it might be mentioned that the production of the Monarch Machine Tool Co., Sidney, Ohio, for the first six months of 1941 was 126 per cent above that for the same period in 1940. The entire output of the plant is for the Defense Program of the United States and England. The number of lathes produced by the company in 1940 was two and a half times that of 1939; it is expected that the production for the full year of 1941 will be at least double that of 1940, which means five times that of 1939. For the entire machine tool industry, the 1941 output is expected to be about four times that of 1939.

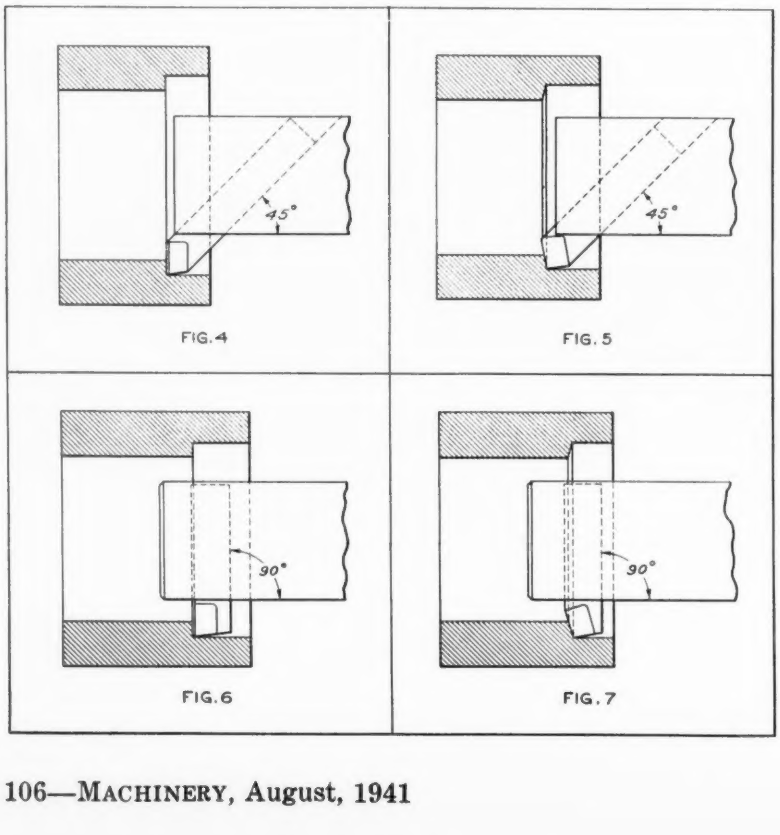


Fig. 4. Boring Bit with 45-degree Side-clearance Edge Angle, Used in 45-degree Boring-bar for Counterboring a 90-degree Shoulder. This Type of Bit should be Used Only where 90-degree Corners are Required. Fig. 5. Bit with 55-degree Side-clearance Edge Angle, which is Ideal for General Boring Operations. Fig. 6. Boring Bit Used with a 90-degree Boring-bar for Counterboring to a 90-degree Shoulder. Fig. 7. Another Bit Recommended for General Boring Operations

An Edge Trimming Milling Machine for the Welding Shop*

CONSIDERABLE time is lost in the welding shop due to the difficulty of cutting and trimming plates, bars, and other parts to size before welding them together. In the shop of Contract Welders, Inc., Cleveland, Ohio, a special milling, chamfering, and scarfing machine was built to perform such operations quickly and efficiently. The machine itself is of a simple design, and welding operations were used extensively in its construction. It consists essentially of a frame to support a hold-down arm and a milling carriage, a raceway along which the milling carriage moves, a spindle on which the various milling cutters are mounted, an electric motor to drive the spindle, a control switch, a hand traversing mechanism, a coolant pump, and a tank to hold the coolant and metal chips.

In operation, the plate to be squared is placed under the hold-down arm and clamped securely in place by hold-down screws. The milling cutter is then traversed along the edge of the plate, removing the required amount of metal. Any type of cutter can be attached to the spindle, and any form of V or U corner or special fillet can be milled along the entire edge. The machine is equipped with a side gage, so placed that the operator can square to length a plate or bar placed against it. There is also a back gage which can be set for cutting edges parallel and to exact width. Plates of different thicknesses and widths can be handled with only slight adjustments of the hold-down arm.

The main part of the machine is of welded steel construction. The top and the ways are supported along their entire length by deep webbed plates, and these are tied together at intervals with C-shaped cross plates. The ends of the webbed plates are terminated in foot plates, which carry the whole load of the machine. The load-carrying part of the frame is concealed by a jacket of thinner metal, which improves the appearance of the machine and also serves as a tank to hold the coolant and the chips removed by the cutter. The ways of this machine are also of steel, and are planed true and scraped to size. The carriage slide is made of steel, with hard bronze welded in place, and this presents an excellent wearing surface against the steel ways.

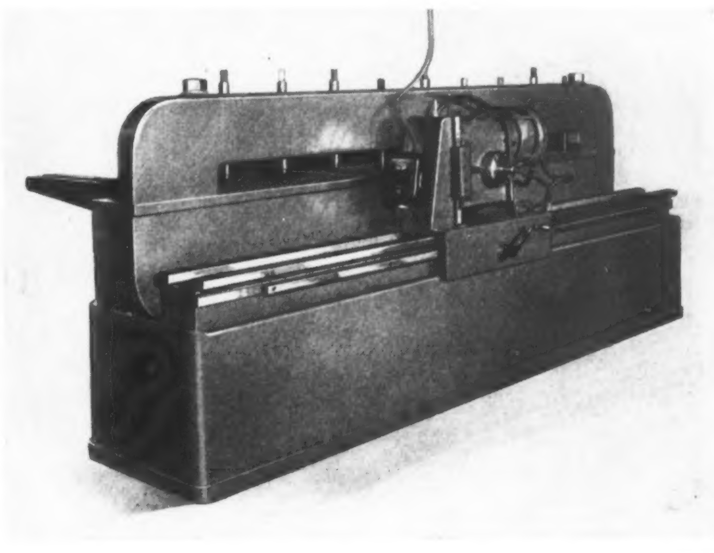
The milling cutter is mounted directly on the nose of the spindle, and is held in place with a long "through bolt." The cutter-spindle is short, heavy, and mounted on spherical roller bearings. A built-in motor driving through a worm and gear supplies the power to drive the milling cutters. The coolant pump is attached to the motor housing. The entire milling head is made with welded steel parts, including the adjusting slides. Throughout the design of this machine, a particular effort was made to secure a clean and attractive appearance.

As this machine was not made to replace an existing piece of equipment, but was designed to perform a specialized function, it is difficult to estimate the savings resulting from the method of construction used. From the standpoint of the milling head and the smaller parts, no great savings were probably realized by making them of welded steel. The main base, however, is about one-half as heavy as it would have been if made of cast iron. With the present weight of about 6000 pounds, the cost of manufacture of this base would be approximately as follows:

6000 pounds of material @ $.03	$180.00
Direct labor only	120.00
Miscellaneous material, gas, wire, etc.	35.00
Total	$335.00

The saving realized by building this base from welded steel amounts to approximately $270, and this does not include savings which result from eliminating the cost of patterns, a considerable item in this case.

One particularly interesting job turned out on



Specially Designed Machine Built by Contract Welders, Inc., to Mill the Edges of Plates, Bars, and Other Parts to Exact Size before Welding

*From a study submitted to the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, in a recent Award Program.

this machine called for 240 1/4-inch plates, 60 inches long, to be given a 1/2-inch taper in the length. These plates could not be sheared, and flame cutting would have caused a camber in them. Twenty plates per hour were readily turned out on this special miller, and the work done was so accurate that about one hundred hours was saved on the job in welding time; the wire cost was also less. As a conservative estimate, the use of this machine has reduced the time on the average welding job by about 10 per cent.

* * *

Airplane Wing-Spar Jig with Horizontal and Vertical Drill Heads

The use of traveling vertical-spindle drill heads on long jigs for wing spars was described in an article published in July, 1940, MACHINERY which dealt with manufacturing methods employed by the Boeing Aircraft Co., Seattle, Wash. This practice has since been extended by the concern to include the use of traveling horizontal drill heads on the sides of the jig.

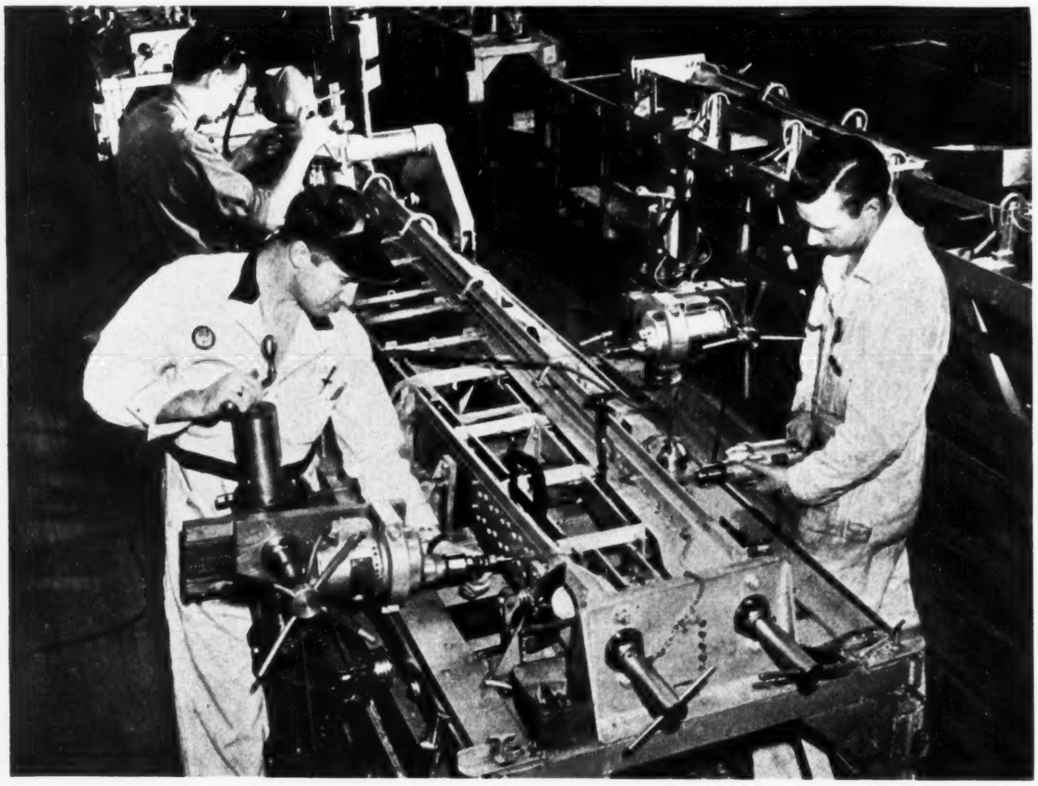
The accompanying illustration shows a jig that is equipped with horizontal-spindle heads on both sides and a vertical-spindle head in the background. The side heads are mounted on slides for convenient feeding of the drill spindles to the work. They are also adjustable vertically on posts. With this arrangement, holes can be quickly drilled, reamed, countersunk, etc., in the proper location on the wing spars, as determined by means of templets that are fastened to the work after it has been loaded into the jig.

Annual Meeting of Welding Society

The American Welding Society has announced plans for its annual meeting, to be held in conjunction with the National Metal Exposition in Philadelphia, Pa., October 20 to 24. With welding playing a role of primary importance in defense, the program for this year's meeting will contain an unusual number of outstanding papers. Headquarters for all the technical sessions, committee meetings, and social events will be the Bellevue Stratford Hotel.

The opening session will be held Monday morning, October 20. Technical sessions will continue mornings and afternoons throughout the week. More than sixty-five technical papers covering welding, cutting, and treating processes will be presented. There will be separate sessions on machinery manufacture, shipbuilding, training of operators, aircraft, automotive work, railway work, structural welding, and welding of armament equipment. Sessions devoted to research and metallurgy will also be held. A great deal of welding equipment and many lines of supplies will be displayed in the exhibit at the Philadelphia Commercial Museum.

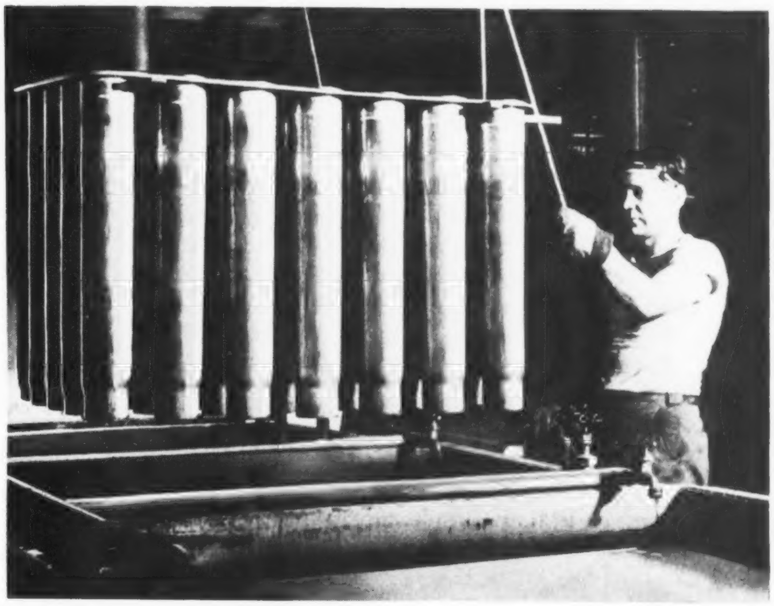
The Lincoln Gold Medal, donated to the American Welding Society in 1936 by J. F. Lincoln, president of the Lincoln Electric Co., Cleveland, Ohio, will be awarded at the annual meeting. The award will be made to the author or authors of a paper published in *The Welding Journal* during the year preceding the annual meeting, which is considered by the Society's Board of Awards to be the greatest original contribution to the advancement and use of welding.



Wing-spar Jig with Traveling Heads Arranged both Horizontally and Vertically for the Drilling, Reaming, and Countersinking of the Numerous Holes Required in Such Work

Munitions Cleaning—1941 Style

A Review of the Methods and Solvents Applicable to the Cleaning of Shells, Cartridges, Guns, Rifles and Other Materiel—First of a Series of Five Articles



By R. W. MITCHELL
Technical Director
Magnus Chemical Co.
Garwood, N. J.

THE technical and trade press is devoting much space these days to the subject of munitions manufacture—and rightly so, because many manufacturers have ahead of them a highly specialized job in this one phase of the huge broad program of defense. Methods of shell manufacture that were adequate, or at least satisfactory, at the peak of production during the last war are today outmoded.

This is due not only to substantial advances in production technique, but also to the changed character of artillery practice. Nothing in the present war has approached the shell consumption of the barrages and artillery preparation of 1914-1918, particularly of heavy ammunition. On the other hand, the rate of fire for anti-aircraft operations far exceeds even the wildest dreams of the artillerymen of the last world war. Thus, our defense program must encompass this established demand for the huge requirements of relatively small caliber anti-aircraft ammunition, and at the same time, prepare for a potential demand for 75-millimeter, 105-millimeter, and 155-millimeter shells of all kinds.

Radical changes in production methods are being instituted on all sides. The most desirable sequence of finishing operations is a sure-fire subject of debate. Elimination of rejections by more careful forging practice and closer control of automatic machining operations are "hot" topics. Bottlenecks of all kinds are being ironed out, but one real source of production delay, as well as of excessive rejections, is practically always passed over in these discussions with casual mention. This undiscussed operation—munitions cleaning—is not an unimportant incident in arms manufacture. It is a vital phase of every production job, whether it concerns the supply of shells for artillery, or cartridges for machine guns and rifles, or whether it is connected with the manufacture of the guns, rifles, and fire control instruments, and the myriad other metal parts that are a part of the materiel of the modern army. Thus, it seems both appropriate and timely to discuss present-day cleaning operations and compounds as they apply to the manufacture of munitions and materiel.

Cleaning of Artillery Shells

In 1914-1918, steel shells were practically all heat-treated. In 1941, with the exception of 155-millimeter shells, which have to possess a yield point of around 60,000 pounds per square inch, heat-treating does not seem to be necessary because of the more suitable metal available today. In the old days, a difficult and delaying operation—machining the interior cavity of the shell—held up production and complicated the cleaning operation. In 1941, interiors of shells, from the 75-millimeter size up to the 105- and 155-millimeter howitzer shells, are being forge-finished, with no need for machining. A certain number of these shells may be produced by the older method, with the interior cavity machined, but as far as possible this is avoided in order to speed up production.

Since the machining operations involved in finishing 75-, 105-, and 155-millimeter high-explosive and chemical shells, as well as 3-inch and 90-millimeter anti-aircraft, 60- and 81-millimeter trench mortar, and 105- and 155-millimeter howitzer ammunition are receiving ample discussion, let us consider the points where cleaning is of importance during the process.

First, let us consider an operation which is not strictly in the cleaning category, but which is, nevertheless, closely concerned with cleaning—the "nosing" of the shell. This is the operation that

gives the shell its ogive, or formed neck at the top, where the fuse is later installed. The ogive may be formed hot or cold. If formed hot, the heating operation leads to the formation of scale, which must be removed by shot-blasting or pickling. The extra operations of heating and cleaning thus imposed have led to the adoption of the cold-nosing method, which eliminates them entirely.

Effect of Cold-Forming Process on Cleaning

By this method the shell is cold-formed in a crank press, following which it is ready for finish-turning of the exterior and setting in of the copper rifling band. The selection of the proper lubricant for this cold-nosing operation is important. If the life of the die is to be long enough to meet today's production demands, the lubricant must be precisely adapted to the operation. A graphited special soap composition, in powder form, has been found to meet the requirements of this cold-nosing operation, giving a run of up to fifty thousand shells per die.

The shell is first swabbed with a light mineral oil, and then dipped into the graphited soap lubricant, enough of which adheres to lubricate the shell for the forming of the ogive. Of course, a lubricant is needed for the hot-nosing operation (still largely used in Canada), and for this, a graphited oil lubricant of the right type is suitable.

However, it is well to point out that, in both the hot- and cold-nosing operations, the cleaning qualities of the lubricants used are important. Subsequent cleaning operations are required to remove any grease, oil, or soap that may be left after the nosing process. If any of the ingredients of the lubricant used are not readily penetrated by the cleaning solution or are not loosened or emulsified completely to insure thorough removal of all foreign matter, the final cleaning operation will be materially complicated and rejections due to poor paint adherence will be numerous.

After the copper rotating band has been forced on the finish-machined shell, the final cleaning operation takes place. There are a number of alternative cleaning methods, with advantages and disadvantages which affect the speed of production, percentage of rejections, and the over-all cost of manufacture. The cleaning problem is not so difficult as it was when the shell was machined on the inside cavity, since embedded metal particles on the interior are not such a problem. Only the oil, grease, and dirt left from previous handlings and the residues from the nosing operation have to be removed.

Forge-finished interiors provide a cavity which is sufficiently smooth and accurate to eliminate machining. Before the shell reaches the machine shop, this cavity has been pickled or shot-blasted to remove forging scale. However, considerable trouble may be experienced in this cleaning operation. Let us consider the various methods employed.

Vapor Degreasing and Alkaline Cleaning Methods

Vapor degreasers are sometimes used for final cleaning. The shell, usually held horizontally on a rack, with ample spacing to insure complete vapor contact and thorough draining of the condensed solvent, passes through the degreaser with satisfactory results. Of course, embedded metal particles and dirt on the exterior are not removed by the vapor degreaser, and if they are extensive on the shell exterior or at the upper portions of the interior, some method of removing them before or after reaching the degreaser is necessary. Careful shop handling can, of course, minimize the extent of this difficulty.

The vapor degreaser, however, is quite a costly method as regards consumption of solvent, and also of heat and condensing water. It does have the advantage of turning out a dry shell, thus preventing rust formation in cases where the final painting, following inspection, is delayed for any reason.

During the last war, alkaline cleaners were the only materials available for cleaning shells, and most of them were based on caustic alkalies. There are a number of reasons why such alkalies must be avoided in cleaning shells, as well as in corresponding operations on shell cases. One is the staining action of such cleaners on copper and brass. Another is the difficulty of removing caustic alkali cleaners by rinsing. Unrinsed alkali in a shell may lead to serious consequences. It causes pitting and poor adherence of lacquer or paint. But much more serious is the danger of alkaline salts of picric acid forming in the shell after loading. These salts are highly unstable and sensitive, and instances were far from uncommon during the last war of premature explosions resulting from this condition.

Then, of course, caustic alkali cleaners constitute a personnel hazard, leading to unpleasant and often incapacitating burns from splashes, drips, or carelessness in handling. Today there are highly effective alkaline cleaners available that do not have the effects of strong caustic action and meet cleaning requirements much better. These will be discussed briefly in the next article.

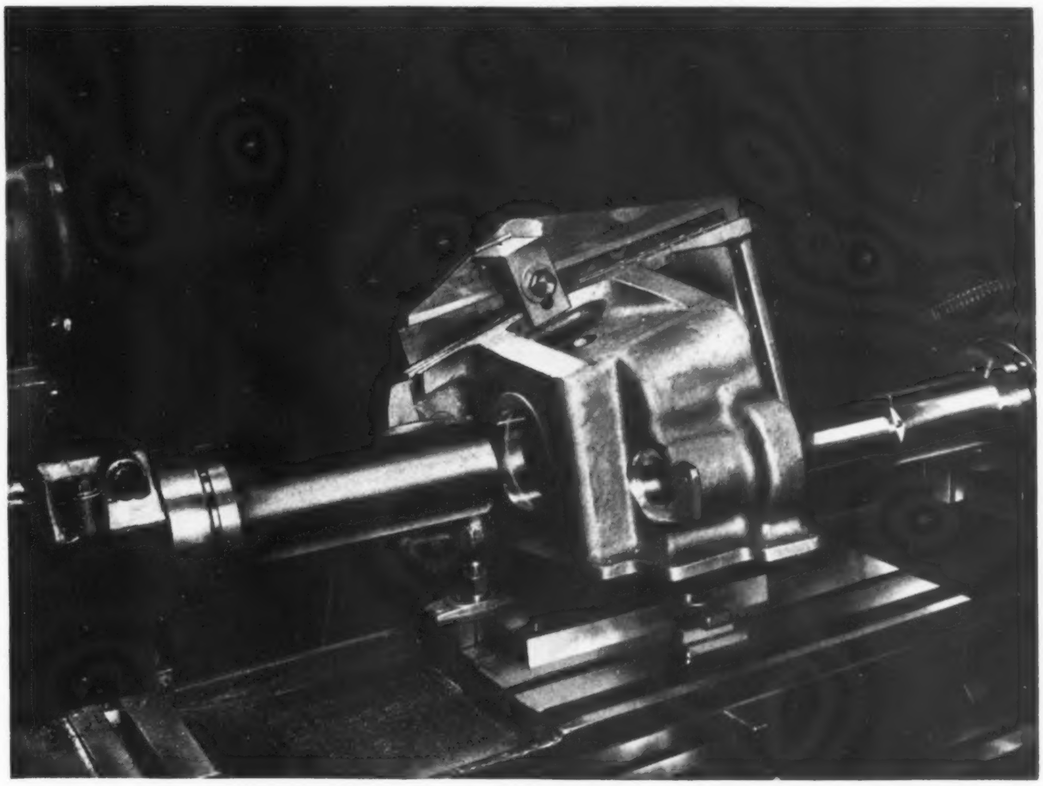
* * *

Increased hardness requirements for steel mill back-up rolls have rendered unsatisfactory the steels commonly used in the past, and high-carbon nickel-chromium-molybdenum steels are therefore being adopted to an increasing extent for this application. A medium-carbon steel of this type, machined after treatment to 350 Brinell hardness, is now employed for heavy-duty gears and pinions in rolling mills by one of the leading builders of such equipment. The ability to meet high strength requirements in gears too large to be liquid-quenched has resulted in the adoption of the same steel, with a simple normalizing treatment.

Precision Boring Operation on Magnesium Casting

BORED holes in a comparatively large magnesium casting must be machined to the specified center-to-center distance within plus or minus 0.0005 inch, and both bore diameters must be held to size within limits of plus nothing, minus 0.0005 inch. The accuracy required in this operation, which is indicative of much of the work performed in the machine shop of North American Aviation, Inc., Inglewood, Calif., is readily obtained by the use of the Ex-Cell-O precision boring machine illustrated. The operation consists of finishing only, the bores having been rough-machined on a milling machine.

The fixture at the back of the machine holds the casting at a compound angle. The holes are bored parallel to each other but at an angle in relation to the base. The cutter-bar of the right-hand head is equipped with two cutters for boring two different diameters, while the left-hand spindle is equipped with only one cutter. The magnesium castings come in right- and left-hand types, which are handled on the same machine by the use of two fixtures of different hands. In changing from one type of casting to the other, the positions of the tool-spindles relative to the front and back of the machine must be reversed. A special set-up fixture is provided to facilitate accurate location of the spindle heads.



Precision Boring Operation on Magnesium Castings that Involves the Use of a Special Fixture which Holds the Casting at a Compound Angle Relative to the Tool-spindles

Holding Irregular-Shaped Work

By W. B. MILES, Manager, Miles-Southeastern Machinery Co., Daleville, Va.

THE article in June MACHINERY describing a low-cost method of making chuck jaws for holding irregular-shaped work was read with interest. The writer has been using regular linotype metal for this purpose, and has been obtaining good results in holding iron castings.

A paper box of the correct size is made of a very thick cardboard. The part to be held is placed in the box. Paper about 1/16 inch thick is cut to provide the required dividing surface between the part to be held and the jaws to be made. This paper is held in place with paper tape. Then the part is leveled up and the type metal poured in at a temperature of from 525 to 550 degrees F.

The metal casting, after cooling, comes out of the paper box easily, and is then machined square on the bottom and sides. It is then ready to hold the parts in a regular milling machine vise. The composition of linotype metal is 10 per cent antimony, 3 per cent tin, and the rest lead. It can be bought from any local printer or newspaper at about 12 cents a pound.

Fig. 1. An Expert Operator is Able to Tell, from the Shape of the Sparks, the Length of the Spark Stream, and the Color, what the Carbon and Alloy Content of the Steel is within Close Limits

Fig. 2. A Portable Grinding Wheel Permits the Spark Testing of Steel in Stock Piles to Insure Adherence to Quality and Prevention of Any Mixing of Stock

Determining the Composition of Steel by the Spark Test

Spark-Testing, as Applied at the Buick Plant, Provides a Quick Method for Checking the Composition of Steel and for Safeguarding against Errors in Steel Applications

WHEN steels of various kinds are used in large quantities, there is always the possibility that the wrong type of steel may be taken from stock for a particular use or that the analysis of a particular grade of steel may fall outside the requirements of the application for which it is intended. Under such conditions, spark-testing, when used in conjunction with chemical analysis, provides an excellent means for quality and use control, according to the Buick engineers who utilize this method extensively. The test is rapid, accurate, and also adaptable to finished parts.

As an example of its wide application at the Buick plant, all transmission gear stock is tested in this way to insure against a possible error in the selection of steel. A test is made of all SA E 1335, X1335, and 1340 steel, which is kept in stock in bars of the same diameter. Valve rocker-arm shaft steel is "sparked" as a check of the chemical analysis. A percentage of all washer stock is tested to check the carbon content. Tool steels and high-chromium oil-hardening steels are spark-tested for alloy content, and a percentage of S A E 1020 rivet stock and of torque-tube stock is also tested.

One of the most important uses of the spark test is in connection with the king-bolt stock, where the physical properties of the steel are vital to safe operation of the car. This part is carburized and a soft tough core is required. The spark test is applied to every part to insure against any high-carbon steel being used.

The spark test is made by bringing the steel against a high-speed grinding wheel, as shown in Fig. 1, and examining the spark stream for characteristics that may be interpreted in terms of approximate percentages of the chemical elements present. The presence and amount of carbon are most easily evaluated in the spark test; an experienced operator can determine its presence in steels up to about 0.30 per cent carbon within plus or minus 0.02 per cent. Molybdenum, silicon, nickel, and tungsten also have characteristic sparks that can be recognized easily in the spark stream. Thus, spark-testing is used for the sorting of steels, the detection of bars of wrong analyses in a lot of steel (as shown in Fig. 2), and a fast approximation of the chemical analysis of the steel. When the analysis of a steel is unknown, a fast and fairly accu-

rate estimate can be made by merely comparing the spark stream with the spark streams of bars of known analyses.

Spark-testing is an art, and the accuracy of the test depends upon the skill and keenness of observation of the operator. This is especially true when slight differences in analyses are being checked. The spark tester must watch many conditions while making the test. The selection of the spark-testing wheel, the speed of the wheel, and the pressure with which the wheel is brought against the steel are all important factors in producing a spark stream that is easily and accurately interpreted. Spark-testing is carried on preferably in a darkened room, since light makes examination of the spark stream more difficult.

The most important requisite in making an accurate spark test is the ability of the operator to interpret the characteristics of the shower of sparks in terms of percentages of chemical elements present in the steel. Each steel will give a spark stream that is peculiar to its analysis. In comparing steels of greatly differing analyses, the characteristics of the spark stream will show easily recognizable differences. In steels of only slightly differing analyses, on the other hand, the differences in the spark stream may be minute and difficult to detect, so that the test requires great skill for accurate classification.

Sparks from the grinding wheel are, in reality, small chips of metal flying off at temperatures sufficient to illuminate them or make them glow. Some spark streams are long and spikelike, while others are bushy and full of "bursts," depending upon the type of steel. There is a theory that the sparks are due to the rapid formation of gaseous carbon oxide below the surface of the chip or globule of molten steel. A sudden escape of gas from inside the globule causes it to explode. According to this theory, carbon is a necessary element for this. Thus, some soft, non-ferrous metals, such as copper and aluminum, produce no grinding sparks. Pure iron produces very few sparks, and low-carbon steel yields very simple sparks (see Fig. 3).

As the carbon content increases, the explosions increase in number and assume intricate patterns (see Fig. 4). They are so profuse in high-carbon steel (Fig. 5) that the spark stream becomes very bushy, and particles from the initial explosion dart out and repeat with secondary bursts, producing a branching network of light.

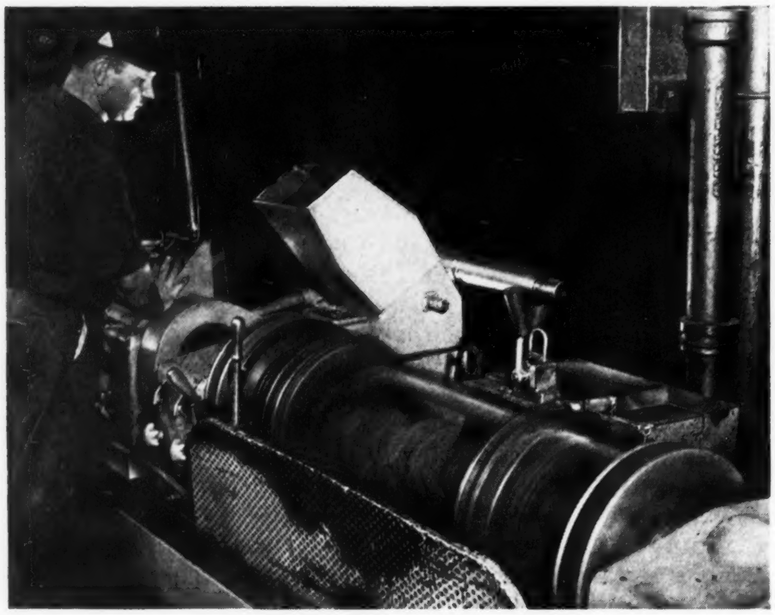
High-speed steel is easily identified by the spark test. A dull color near the wheel and the long length of the spark stream are characteristic. Manganese steel yields a stream of great brilliance, while sparks from chromium steel, although similar to those of high-speed steel, are less brilliant in color near the wheel and the stream itself is thinner.

Fig. 3. The Spark Stream of S A E 1010 Low-carbon Steel Having a Carbon Content of 0.05 to 0.15 Per Cent. The Spark Stream is Thin, and Few "Bursts" are Seen

Fig. 4. The Spark Stream of S A E 1050 Steel Having 0.45 to 0.55 Per Cent Carbon. The Stream is Similar to that of High-carbon Stock, but has Fewer "Bursts"

Fig. 5. The Spark Stream of S A E 1070 High-carbon Steel Having 0.65 to 0.75 Per Cent Carbon. Characterized by its Bushy Appearance and by Numerous "Bursts"

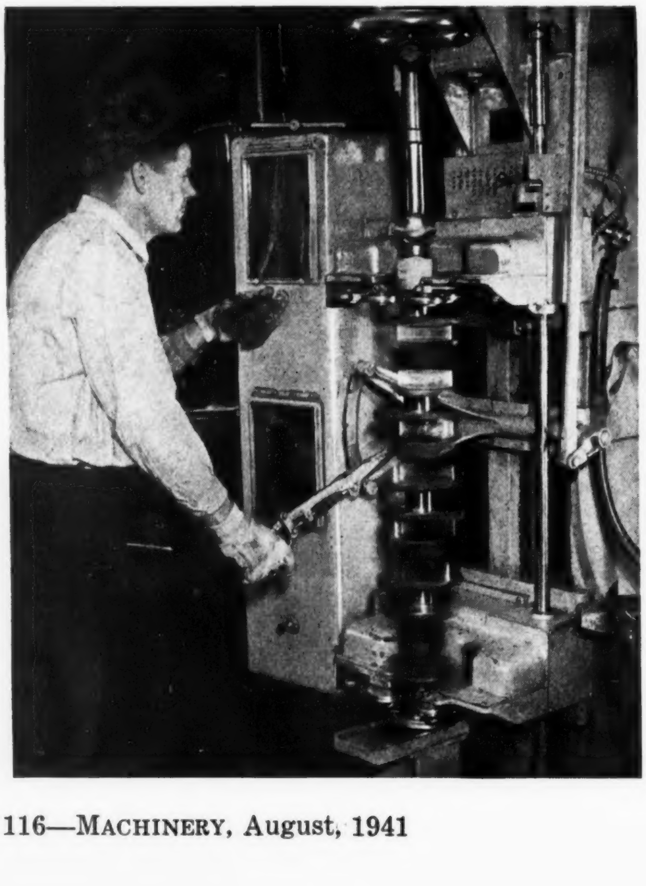
How Buick Builds a Balanced Engine

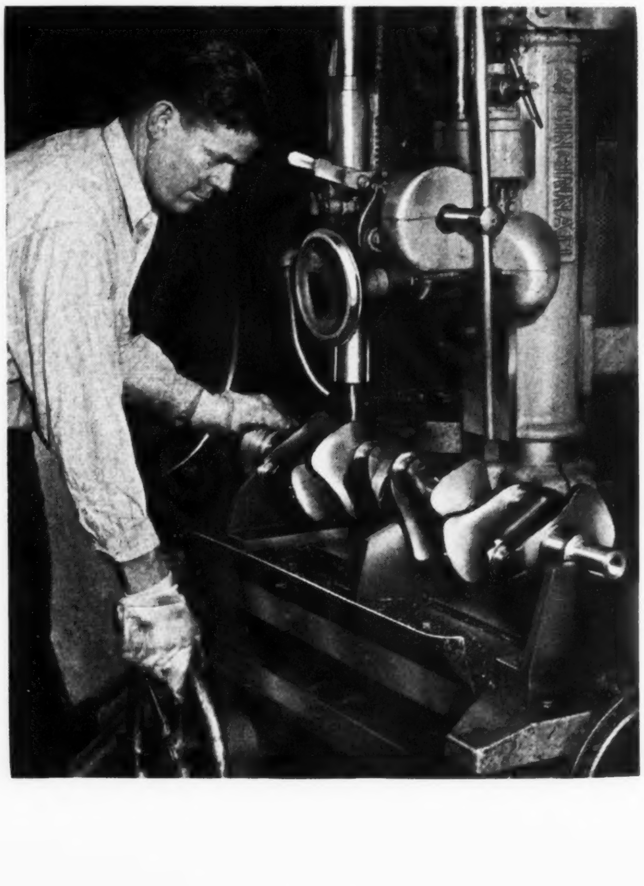


Mass-centering of the crankshaft is one of the most important operations in obtaining the fine balance of a Buick engine. Before machining, the crankshaft forging is spun in the mass-centering machine and the exact mass-center of the forging is determined. This permits accurate machining and results in a crankshaft that is in good balance when the machining is finished. Further balancing operations follow

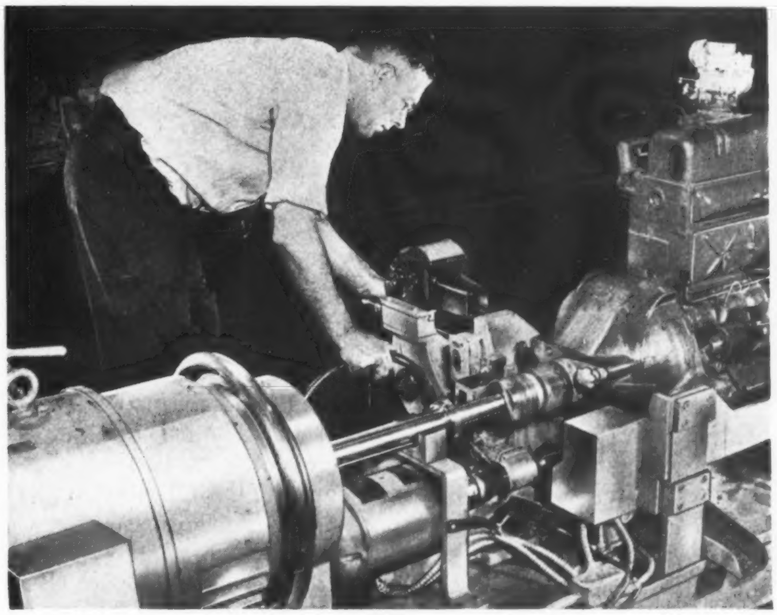
After the crankshaft is machined and ready for assembly, it is placed in this balancing apparatus and spun. Any out-of-balance is registered electrically by a light beam on the frosted glass shown at the left of the machine. The location and amount of the out-of-balance is automatically determined, and stock is removed from the crankshaft to bring it to within 3/8 ounce-inch of perfect balance

The crankshaft is drilled to remove metal and to bring it within the balance limits. This is done after the shaft has been spun on the balancing machine and the amount and location of excess weight determined. There are many separate balancing operations in the Buick plant covering such important parts as clutch assembly, connecting-rods, pistons, drive-shaft, torque tube, flanges, and bearings





Another important operation. Here the harmonic balancer, which is mounted at the front of the crankshaft to eliminate whip or vibration, is brought to within 1/4 ounce-inch of perfect balance before being assembled to the shaft



Every Buick engine is balanced after assembly on this special machine. The crankshaft is connected to a motor-driven shaft and revolved at critical speeds. The resulting vibration is measured by electric gages. Stock is then removed from the flywheel, when necessary, to bring the engine to within 3/16 ounce-inch of perfect balance

Do's and Don'ts to be Observed in the Use of Carbide Cutting Tools

Courtesy Carboloy Company, Inc.

Don't use a rocker support under the tool.

Don't set tools above or below the center line.

Don't use a hammer on the cutting end of the tool.

Don't use inclined tool-holders.

Don't let the tool rest against the work when tightening the clamping screws.

Don't use pointed clamping screws.

Don't use tools with excessive overhang.

Don't dip the tool in any liquid while it is hot.

Don't use a small stream of coolant.

Don't stop the spindle before disengaging the feed.

Don't use "any old wheel" for grinding carbide tips.

Don't run a carbide tool until it will not cut any more.

Don't hold the tool motionless too long against the wheel when grinding carbide tips.

The "do's" may be stated as follows:

Always use a flat, rigid base.

Always set the tools approximately on the center line.

Always use tool-holders designed to hold the tools in a horizontal plane.

Always use dog-point or flat clamping screws.

Always allow the tool to cool slowly in the air.

Always use a generous flow of coolant, and if possible, force the coolant under the chip and against the cutting edge.

Always use silicon-carbide or diamond wheels for grinding carbide tips.

Always sharpen the carbide tools at regular intervals to obtain longer life.

Always keep the tool moving across the wheel when grinding to avoid localized overheating.

* * *

Standardization of Reamers

The American Standards Association has approved as an American Standard the dimensions for reamers submitted to it by the following sponsor organizations: The Society of Automotive Engineers, the National Machine Tool Builders Association, and the American Society of Mechanical Engineers. The new standards are published in a 50-page booklet, obtainable through the American Standards Association, 29 W. 39th St., New York City.

Engineering News Flashes

New Rubber Product Acts as Electric Conductor

Tires made of a special rubber compound having a million times the electrical conductivity of tires made of ordinary rubber have been developed by the B. F. Goodrich Co., Akron, Ohio, for use in manufacturing plants where static electricity constitutes a fire and explosion hazard. These tires prevent the accumulation of charges of static electricity great enough to produce a spark when the vehicle comes in contact with other objects. The new product, called "Conductor Industrial Tires," is expected to be of especial value in plants engaged in the manufacture of munitions, gun powder, and other inflammable or explosive materials or products. One of the first applications of the compound was for tail-wheel tires for aircraft, to carry off the static electricity built up during the flight of the plane. This electricity is dissipated when the wheels come in contact with the ground.

Plastic Mold that has been in Use for Forty-Six Years

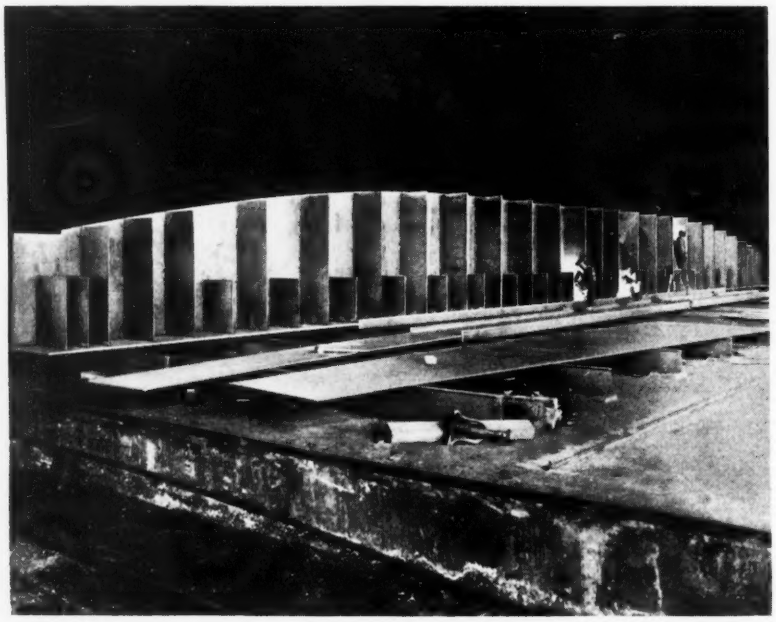
The plastics industry is generally regarded as a development of recent years, but one mold at the General Electric plastics plant in Pittsfield, Mass., has been in use for forty-six years and is still giving satisfactory results. It is a mold for an end insulation ring for a commutator. When the mold was first used in 1895, the insulation ring was made from a combination of rubber, asbestos, and sulphur, and was produced by preforming in a cold mold and then finishing in a hot mold hydraulic press. Today, parts are still being made from the same mold. A phenolic-plastic material is now used for producing these parts in a regular compression molding press.

Air-Conditioning the Gloved Hands of Workers Handling Hot Objects

Beauty-parlor methods suggested an improvement in the handling of sealed-beam headlamps at the Lamp Division of the Westinghouse Electric & Mfg. Co. This is especially interesting as an indication of how ideas for industrial improvements are conceived. It all started when Miss Meister, an employe of the Lamp Division, was getting a permanent wave. Her hair was being cooled by applying cool air from an air hose. The idea occurred to her that this cooling method could be applied to her work. The suggestion was made and adopted, with the result that the gloves of the operators who handle the hot sealed-beam headlamps are now air-cooled.

The headlamps are carried out of an annealing furnace on a moving conveyor. The operators remove the lamps from the conveyor with their gloved hands. The lamps are so hot that, even with asbestos gloves, burns from the continual heat were not unusual before the cooling system was adopted.

As a result of the air-cooling idea, a low-pressure air hose now extends into the gauntlet of the glove, providing a circulation of cool air inside of the



A Giant All-welded Girder for an Overhead Traveling Crane Built by the Cleveland Crane & Engineering Co., Wickliffe, Ohio, which is Believed to be the World's Largest All-welded Crane Girder. When Completed, the Girder will Weigh 45 Tons, have a Span of 105 Feet, and be 8 Feet High at the Center

glove and preventing burns. One of the effects of the air-cooled gloves is an improvement in the product, since a change in the preheat temperature is now permissible, resulting in less shrinkage in the lamp glass.

New Air Hose for Pneumatic Tools Reduced One-Half in Weight

A specially designed light-weight air hose for pneumatic riveters, chippers, and other pneumatic tools has been developed by the United States Rubber Co., New York City. The new product, which weighs only 20 pounds for each 100 feet of hose, reduces to one-half the load carried by workers handling pneumatic tools. The reduction in weight has also increased the flexibility of the hose, making it more convenient to handle in close quarters. It is stated that strength has not been sacrificed by lightening the hose. The bursting strength of the new hose is approximately nine times the average operating pressure encountered in pneumatic tool service.

Mobile Electric Substations Built Ready for Service

The latest means for quickly supplying or restoring electric power in cases of serious emergencies is a completely factory-built mobile substation. One such station of 1000 K.V.A. capacity has been delivered by the General Electric Co., Schenectady, N. Y., to the Central New York Power Corporation at Syracuse, N. Y. This mobile substation is the first of its type. It is mounted on a special chassis, and can be hauled at speeds up to 40 miles an hour. The over-all dimensions of the unit are: Height, 11 feet 6 inches; length, 21 feet; width, 8 feet. For low clearances, the height can be reduced to 9 feet 10 inches. The total weight of the equipment is approximately 10 tons. A forced oil cooling system is being used to permit the substation to be constructed in compact weight and size.

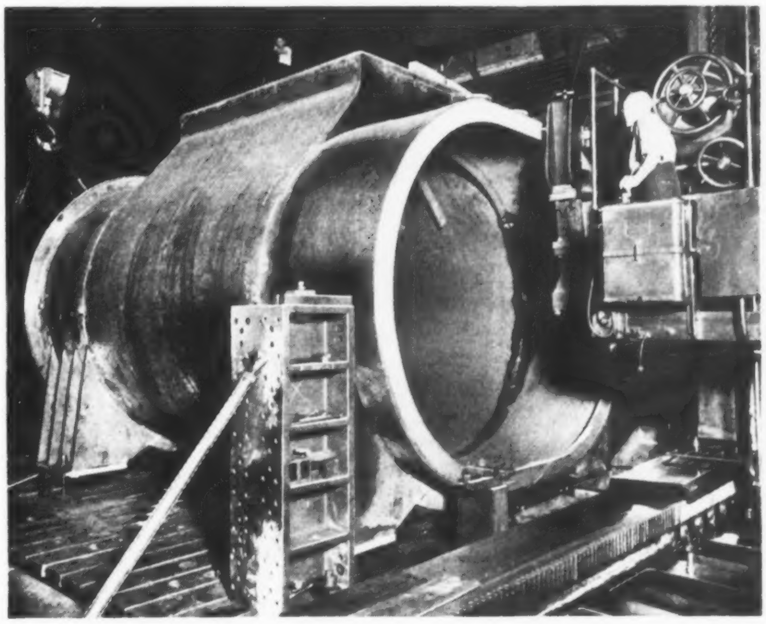
This substation consists of one three-phase, 1000 - K.V.A. transformer, with primary and secondary switching equipment and lightning resistors. It is designed to take power from high-voltage lines of 11,000, 13,200, 22,000, 33,000, or 44,000 volts, transform it and supply it to systems of 230, 460, 2300, 4000, or 4600 volts. It is thus one of the most flexible transforming devices ever constructed.

This mobile substation makes the work of supplying or restoring power to customers of the central station in an emergency a comparatively simple matter. Similar mobile substations are now being manufactured for other utility customers of the General Electric Co.

Instrument Dials that Stay White Made from Plastics

White instrument dials that are not discolored by high temperature, light, chemical fumes, or moisture are being made at the Westinghouse Meter Division, Newark, N. J., from a recently developed liquid plastic material which is sprayed on metal in the same way as lacquer or paint. While lacquered or phenolic plastic dials changed color, in tests, when subjected to high temperature or acid atmosphere, dials coated with the new plastic remained practically unchanged. The liquid plastic hardens on the metal surface by quick heating, and is then completely dried by baking in an electric oven.

In order to avoid difficulties from dust and other particles carried in the air, the room in which the spraying is done is sealed tightly and is supplied with filtered air under slight pressure, so that no outside air will be admitted.



Machining the End Flanges of a 9- by 13-foot Oval by 18-foot Long Condenser Shell in the Shops of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. This Shell, Weighing Approximately 35,000 Pounds, is of All-welded Construction and is Part of a Surface Condenser for Use with a 15,000-K.W. Steam Turbine

Does the Wagner Act Best Serve Communists or Labor?

To demand the complete revision of the Wagner Labor Act is not to oppose unions or union membership. Unions existed, increased in membership, and played an important part in our industrial organization before there was any Wagner Act; unions will continue to serve important and useful purposes after the Wagner Act has been revised by a Congress that has returned to common sense and fair play. But an Act that the evidence now available shows to have played chiefly into the hands of racketeers and revolutionary communists has no place in American life.

No fair-minded person doubts that the strike in the North American Aviation plant, for example, was inspired and led by communists. Responsible leaders of the CIO have expressed themselves to that effect. Colonel Branshaw, in control of the plant as a representative of the Government and the Army, refused to rehire some of the strike leaders, and Attorney General Jackson said that the leaders of the strike were followers of "the Communist party line."

Communist Influence in the Recent Labor Disputes

The *New York Times*, in a recent editorial calling attention to the refusal of Colonel Branshaw to rehire some of the strike leaders, said: "The response of these leaders throws a brilliant light on the kind of labor legislation under which the country has been living in recent years. The suspended men have filed 'discrimination' charges with the National Labor Relations Board, holding that they were dismissed for union activity."

Just what the Board will decide is not known at the present writing. The decision may be affected by the fact that it was not the company, but actually the Government itself, that refused to rehire these men. The important point, however, is not what this decision *will be*, but what it *would have been* if the company, on its own responsibility, had refused to rehire these men. Basing one's conclusion on past decisions, it is obvious that the company would have been found guilty of having violated the Wagner Act; it would have been forced to reinstate these men, who had acted not only against the best interest of the company, but against the best interest of the entire nation. And not only would these men have been reinstated, but they would have been reinstated with back pay from the day when the company had refused to rehire them.

Past decisions of the Labor Board have made many employers hesitate to lay off employes even when they were known to be communists and disloyal, not only to the employer, but to the United States. It is difficult to prove that a man is a revolutionary communist; and, furthermore, if the employer could prove beyond question that a man was disloyal to the nation—what then?

Again we quote the *Times* for the answer: "J. Warren Madden, then chairman of the National Labor Relations Board, told a Senate Committee in April, 1939, that an employer who called a union leader a communist might be held guilty of coercion under the Wagner Act, even if his statement were completely true." In other words, the Labor Board must allow its machinery to be used even by known labor racketeers and known communists, because the Act does not recognize the existence of communists, labor racketeers, or disloyal employes. There is no provision in the Act that requires such men to come before the Board with clean hands.

Wagner Act Does Not Seek Fair Play, But One-Sided Decisions

The Wagner Act, though allegedly designed to curb evils in industry, has created more evils than it has cured. It was obvious, at the time the Act was passed, that this would be so, because the Act assumed that all the wrongs were on one side and all the rights on the other. The only unfair practices forbidden, or even mentioned in the Act, were practices by employers. Yet, in the North American Aviation strike, officers of the Army found it necessary to assure the workers that they would be protected against violence on the part of strikers if they came back to work, and also protected against violence by strikers in their homes. The Wagner Act knows nothing about that kind of violence, coercion, or unfair practice. The Act has much to say about coercion on the part of an employer, but makes no mention of coercion or violence on the other side.

It is Time to Return to the American Idea of a Square Deal

Now any open-minded man may well ask: Is this in accordance with traditional American fairmindedness? And more and more the American public is beginning to ask: How long is Congress going to allow the unfair, discriminating Wagner Act to remain the law of the land?

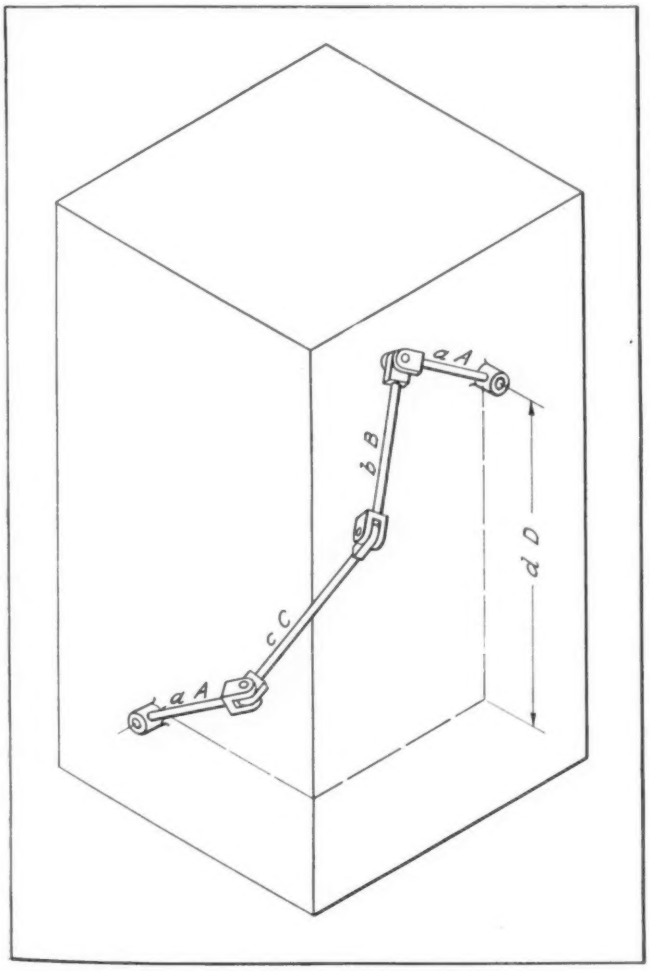
Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Space Linkage Mechanism for Transmitting Oscillating Crank Motion

By MICHAEL GOLDBERG

An oscillating motion can be transmitted from a crank that oscillates in one plane to another crank located in a different plane by means of a double-linkage arrangement such as shown in the accompanying illustration. The use of a single connecting-rod for this purpose was described in May, 1940, MACHINERY, page 103. There are cases, however, where obstructions or interferences may make it impossible to join the two links by a single connecting-rod. The interference can sometimes be avoided by the use of a connecting-rod made in two pieces which are simply hinged together, as described in the present article. The main frame, the two cranks, and the two parts of the connecting-rod, as here illustrated, constitute a hinged movable five-bar linkage in space.



Space Linkage Mechanism for Transmitting Oscillating Motion

A five-bar linkage of this kind must be designed to have certain mathematical relationships between its various members in order to operate. Let the length of a link be defined as the length of the common perpendicular between the hinges in the link. Let the twist of a link be defined as the angle between the hinges in the link. In the diagram and in the formulas below, the small letters refer to the lengths of the links, while the corresponding capital letters refer to the twists of the links.

The five-bar linkage will operate if the following conditions are observed: (1) The two cranks have equal lengths a; (2) the two cranks have equal twists A; (3) the sum of the lengths of the two parts of the connecting-rod is equal to the length of the main frame, $b + c = d$; (4) the sum of the twists of the two parts of the connecting-rod is equal to the twist of the main frame, $B + C = D$:

$$(5) \quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

To simplify the diagram, the cranks are shown to be oscillating in two perpendicular planes. The twist D of the main frame or link is, therefore, a right angle. Angle D need not, however, be restricted to a right angle; any other angle between the planes can be handled just as readily.

Mechanism Equipped with Suction Cup for Picking up and Feeding Thin Plates

Three distinct phases in the sequence of movements imparted to suction cup W of the plate-feeding mechanism shown in the accompanying illustration are produced and controlled by a single cam which transmits a sliding movement to the rack or actuating rod R. The three phases of the movement required to pick up plate A and carry it to the position shown at D, as indicated, consists of a vertical movement of suction cup W which raises plate A to the first position clear of the pile; a circular motion which carries the plate to the second or vertical position; and the final horizontal movement which carries the plate to the third position at D.

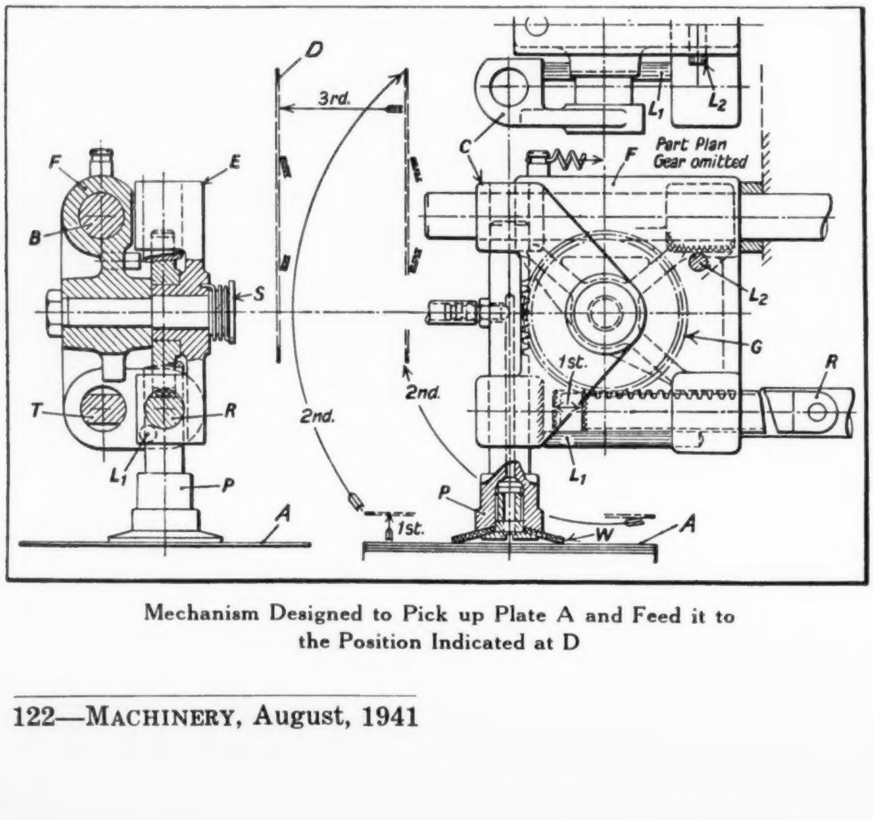
The light frame F of the mechanism slides on bar B and a flatted rod T, both of which are firmly fixed in the machine body. The triangular-ribbed frame F has its upper portion formed into a long boss. A central boss carries a horizontal shaft S on which a carrier C is so mounted that it can rotate freely through an angle of 90 degrees. The maximum counter-clockwise position of the carrier, as shown by the full lines, is determined by a limit pin or stop L_1. A second stop-pin L_2 restricts the maximum clockwise rotation.

A gear G having a pitch diameter of 3 1/2 inches, freely mounted on the hub of carrier C, engages rack teeth on a hollow plunger P and the actuating rod R. Plunger P is provided with a suction cup W at the lower end. The required suction is maintained in cup W by connection with an exhaust pump and valve system.

A spiral spring, exerting a force of 2 to 3 pounds at the rack on rod R, tends to rotate carrier C in a counter-clockwise direction. Another tension spring, exerting a force of 4 to 5 pounds, tends to move slider frame F to the right. The weight of plunger P, which is approximately 1 pound, tends to push this member downward.

The relative strength of the springs and the weight equivalent of the plunger are important, as the movements of the several elements depend on the fact that these springs must collapse in a predetermined order. In operation, horizontal rack-rod R moves to the left to rotate gear G and raise plunger P, with its plate, until the shoulder on the plunger strikes the lower boss face of carrier C, actuating rod R being in such a position that it will not interfere with carrier C.

Continued movement of rod R to the left rotates gear G and carrier C through a quarter-turn against the action of a spiral spring until it is stopped by limit pin L_2. Any further movement of rod R now causes the slide assembly to move to the left against the pull of the spring. A reduction in the height of the pile of plates is automatically compensated for by a longer return movement of rod R by its actuating spring, which causes the plunger to fall to the pick-up position, regardless of the height of the pile of plates. Assuming that the plates are 6 1/2 inches square, the third or horizontal motion must be 2 3/4 inches to obtain adequate swing clearance. H. S. G.



Mechanism Designed to Pick up Plate A and Feed it to the Position Indicated at D

* * *

Eliminating Vibration in Aircraft Plant

According to the B. F. Goodrich Co., "Vibro-Insulators"—devices of metal and rubber designed to reduce vibration in machinery—have greatly aided in eliminating vibration in one of the plants making aircraft engines. In the division of the General Motors Corporation that manufactures the Allison airplane engines, machines causing excessive vibration were formerly installed on the first floor, away from precision machining equipment, such as grinding machines and precision boring machines. By the installation of Vibro-Insulators, it has been possible to move broaching machines from the first to the third floor of the plant and to locate them near precision grinders without any effect on the finish obtained with the grinding machines. Vibro-Insulators have now been installed on all machines that are so located in the production lines that vibration caused by them would be objectionable.

* * *

University Professors to Study Aircraft Engine Construction

In order to offer university professors and instructors an opportunity to become familiar with the problems of the aircraft industry, the Pratt & Whitney Division of the United Aircraft Corporation invited more than twenty college professors and instructors to spend their 1941 summer vacations at the company's East Hartford, Conn., engine plant. By visiting this plant, these educators will also gain some idea of the type of engineering graduates best suited for the aircraft industry. The plan is to have the visiting educators actually work on engineering and production problems, thus learning through practical experience. In this way, these instructors will acquire a comprehensive knowledge of the aircraft industry—a knowledge that cannot be gained in any other way.

Types of Drawing Dies Used for Forming Sheet-Metal Parts

A General Analysis of Drawing Dies, with Special Consideration of Features Necessary for Successful Operation

By CHARLES R. CORY*

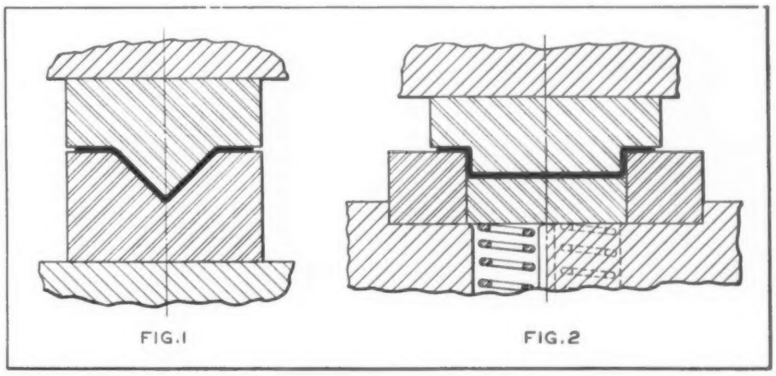


Fig. 1. Cross-section of Solid Type Forming Die
Fig. 2. Pressure-pad Type of Forming Die

IN forming parts from flat sheet metal, either a forming die or a drawing die may be employed. When a forming die is used, the part is produced either by a solid spanking action, such as is obtained with the die shown in Fig. 1, or by a pressure-pad action, such as produced by the die shown in Fig. 2. With the latter die, the central part of the blank is held by the pressure pad, while the outer portion or rim of the blank is formed by stationary members.

In the case of the drawing die shown in Fig. 3, a pressure pad or blank-holder *A* holds the scrap metal around the outside of the blank by pressing it against die member *C*. As die *C* travels downward over stationary punch *B*, it forms the middle portion of the blank to the desired shape. The distinction between a forming and a drawing die is that, in a forming die, the middle part of the blank is held by the pad and there is no side movement of the metal in this pad-held area, whereas in a drawing die, the outside of the blank is held by the pad, so that the metal under the pad travels inward during the drawing operation. The metal that travels inward in this manner provides the extra surface area required for the formed part.

The absence of movement of the material in the pad area of a forming die makes it possible to use blanks of the required size, produced in a blanking die prior to the forming-die operation. Under these conditions, no allowance is necessary for trimming after the drawing operation, whereas with a drawing die allowance has to be made for the scrap stock that must be trimmed from around the outside of the drawn part, the variation in the amount of metal moving inward over the blank-holder surface from various directions making it impossible to cut blanks to the exact size required for the finished piece. The scrap material around the outside of the part must thus be removed by a trimming die after the drawing operation.

The lower cost of a blanking die, as compared with a trimming die, favors the use of a forming die. The saving in sheet-metal stock is another advantage obtained by using a forming die. If right- and left-hand parts are to be produced, a single-blanking die will suffice, whereas a double-trimming die would be required if a drawing die were employed. If the blank is of such shape that stock can be saved by a rough-blanking die, operated as a double-run blanking die—that is, with every other blank reversed so that each blank nests within another — then the use of a drawing die has the further disadvantage of requiring an extra rough-blanking operation. A drawing die must, nevertheless, be used for making parts that cannot be made in a forming die.

*Die Engineer, Fisher Body Division, General Motors Corporation, Detroit, Mich.

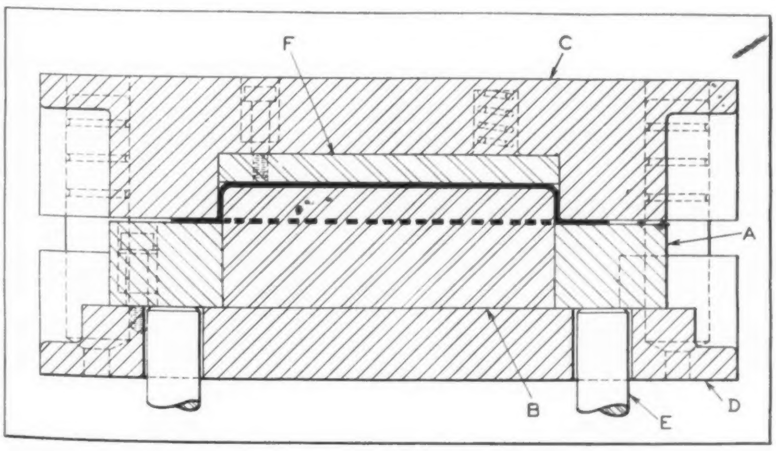


Fig. 3. Single-action Drawing Die

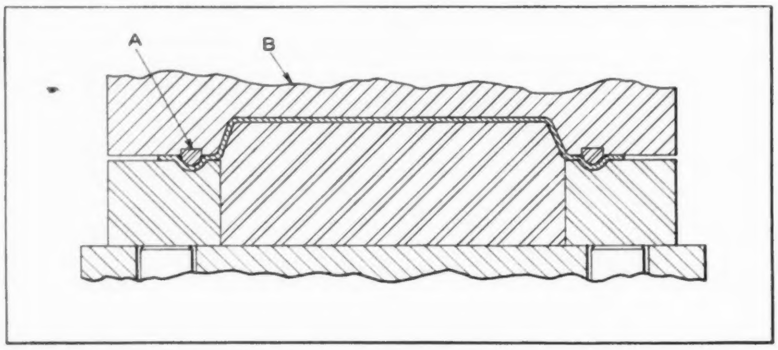


Fig. 4. Section of Drawing Die Equipped with a Drawing Bead A

A forming die cannot be used if the part is so shaped that there is no relatively flat surface on which the pressure pad can obtain a hold or grip; if the part cannot be formed without wrinkles due to excess metal; if the metal starts to tear from the edges of the part, due to stretching while it is being formed; or if the part is comparatively flat, so that its shape must be set by a drawing-die action which will take the spring-back out of the metal. In general, the thicker the stock, the easier it is to form a part of a given shape in a forming die, and, therefore, the less reason there is to use a drawing die.

Single- and Double-Action Drawing Dies

The drawing die shown in Fig. 3 is used in a single-action press. The blank is loaded on the blank-holder ring *A*, which is normally slightly above the punch *B* when the die is open. Die member *C*, on its down stroke, forces the blank-holder ring downward, forming the blank to the required shape over punch *B*, which is mounted on die-shoe *D*. The blank-holder ring derives its pressure either from air-operated pins *E*, which extend down to the press air cushion, or from springs mounted in the die.

The pressure of the blank-holder keeps the outside of the blank flat as the metal is pulled inward by punch *B* to supply the extra metal required for forming the part. The restraining action of the blank-holder eliminates wrinkles by preventing excess metal from being pulled inward too easily. If the metal tears when the die is being tried out, the blank-holder pressure must be reduced to allow the metal to pull in more easily or sharp corners on the punch or on the drawing corner of the die member must be rounded off; or else the width of the scrap metal opposite the point where the tear appears must be reduced, so that the metal can be pulled in more freely.

If instead of tears, which indicate too much stretching of the metal, there are wrinkles, it is necessary to restrain the inward flow of metal by increasing the blank-holder pressure, or by increasing the width of scrap so as to create more resistance to metal movement, or by adding a drawing bead, as shown at *A*, Fig. 4. As the metal flows inward past the drawing bead, an ironing action occurs, which prevents wrinkles from forming on the blank-holder surface inside the drawing bead. A drawing bead need not be added all around the die, but only in the region where the stock pulls inward too freely and thus becomes wrinkled.

In some cases, more than one bead may be necessary. Although the drawing bead is added primarily to prevent wrinkling of excess metal, drawing beads may also be used to prevent the blank from tearing, due to excessive stretching, or lack of metal. Since drawing beads permit the blank-holder pressure to be decreased, the net result is less tension in the metal. Drawing beads cannot be used if the blank-holder pressure is insufficient to close the die and blank-holder and maintain them in a closed position with the blank formed to the bead shape. The drawing bead should be located as close to the drawing edge of the die as possible, in order to reduce the size of the required blanks.

A spring knock-out, such as shown at *F* in Fig. 3, is used if the finished part has vertical walls that might cause it to stick to the die member *C*. The spring pressure on knock-out *F* must be light, in order to prevent the part from being collapsed on the up stroke through the downward pressure on knock-out *F* and the upward air pressure exerted on blank-holder ring *A*. Spring plungers may be used instead of the spring knock-out plate *F*. If the part does not have vertical walls, the die member may be made solid without a knock-out plate, as shown at *B* in Fig. 4.

If the drawing operation is too difficult for the blank-holder pressure available from the air cushion of a single-action press, the die should be made for use on a double-action or a toggle press. The operation of a double-action press die, such as

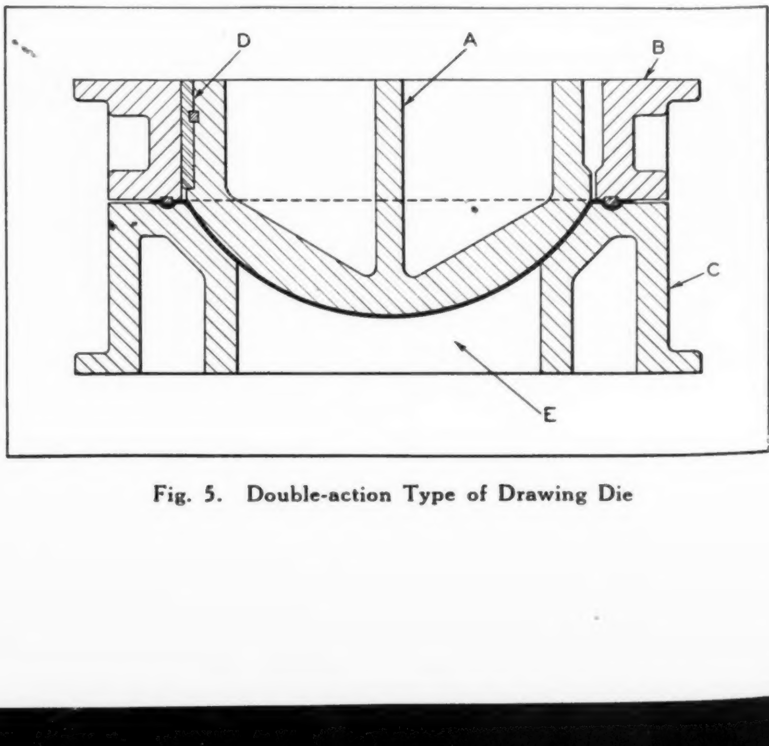


Fig. 5. Double-action Type of Drawing Die

shown in Fig. 5, is essentially the same as that of a single-action die, except that the die is inverted. Punch *A* is attached to the inner ram of the press, blank-holder ring *B* is secured to the outer ram, and die member *C* is fastened to the bed of the press. The outer ram brings the blank-holder down in contact with the blank, and then dwells while the punch is brought downward by the inner ram to draw the part.

A double-action rather than a single-action die is used if a greater amount of blank-holder pressure is required to prevent wrinkles from forming either in the blank-holder surface or in the part itself. Such a condition exists if the part is large or has a great depth of draw, particularly with steep walls or sharp corners. The same condition also exists where a long length of drawing bead is necessary or where the amount that the blank metal is capable of stretching is equivalent only to the difference in areas between the finished part and the flat blank, so that it is necessary to lock the blank in place by means of the blank-holder.

The punch is guided in the blank-holder ring usually by guide strips *D*, Fig. 5, which are keyed to the punch and fit against surfaces milled vertically in the cored opening of the blank-holder ring. Occasionally, strippers or lifters are used in the opening of the die to facilitate removal of the part. Usually, die member *C* can be cored out under the punch area, as shown at *E*. There should be, however, several spots where the die member fits the punch. These spots will serve as set-up stops when adjusting the press ram height. It is also necessary to fit the die member to the shape of the part if there is a reverse curve on the part or if there is a sharp corner that requires "spanking."

It may be advisable to draw the part in two directions from the blank-holder surface *A*, as is done in the die shown in Fig. 6. In this die, the upper blank-holder *B*, operated by the outer ram,

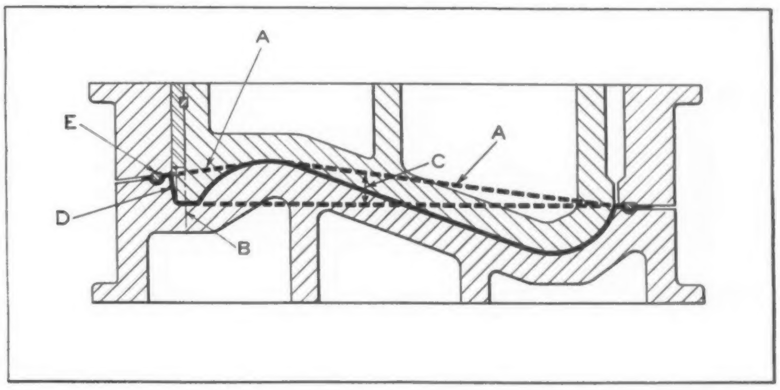


Fig. 7. Double-action Drawing Die Designed for Same Work as Die Shown in Fig. 6

first comes in contact with the blank on the lower blank-holder *C*, which is supported by air-pressure pins *D*. As the lower blank-holder is forced downward, the upward-formed part *E* of the drawn shape is completed. Later, as the inner-ram operated punch *F* moves down, the lower part *G* of the drawn shape is completed.

The same type of part could be drawn with a double-action drawing die such as shown in Fig. 7, with the blank-holder line *A* so located that the drawing action is all downward from this line. The disadvantage of this method is that it requires a blank of a larger size, since, at the front and rear sides, there is additional scrap equal to the drawing height *C*, and at the left side, there is scrap extending from the trimming line *B* to a point outside at the drawing bead *E*. The drawing depth *D* at the left side cannot be reduced by tilting the blank-holder line *A* downward at a sharper angle, since this would result in a condition of excess metal, as will be explained in connection with Fig. 8.

For a successful draw, the metal must be in a state of tension or stretch as it is formed to the finished shape. Such a condition exists when the area of the finished part in any particular region is greater than the area of the blank in that same region before the drawing operation.

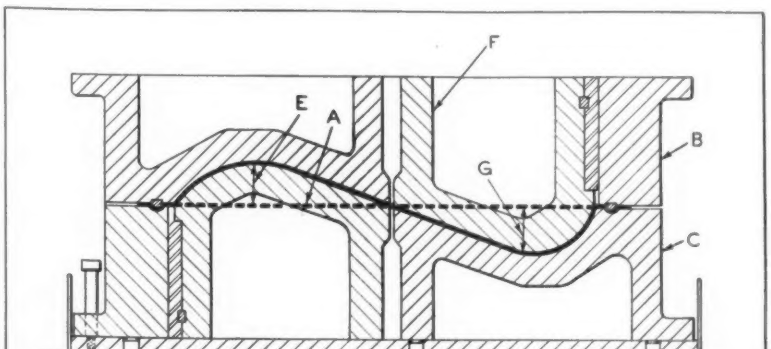


Fig. 6. Combination Air- and Toggle-action Drawing Die

The part shown in Fig. 8 has a convex shape, which is more difficult to draw than a concave shape. The total length of the blank-holder line *A* from point *C* to point *D* is less than the total length of the finished part line *E* between the same points, which indicates a condition of stretch when considering the whole panel. However, if the area between the radial lines *F* and *G* were considered, the blank-holder line would be longer than the finished part line. In that area, there is danger of wrinkles due to excess metal. That is the reason the blank-holder line cannot be tilted downward close to the side trim line *B*, as shown by line *H*. A blank-holder line similar to *H* would decrease the metal

size required, but would probably result in wrinkles at the center of the part.

A concave-shaped part does not usually have a region where there is danger of excess metal, and, as a rule, the blank-holder line is close to the trim line. In some cases, stock can be saved by allowing the trim line to extend into the blank-holder surface. If the blank-holder does not have the same shape as the finished part, it is necessary to re-form the portion of the part that is in the blank-holder surface.

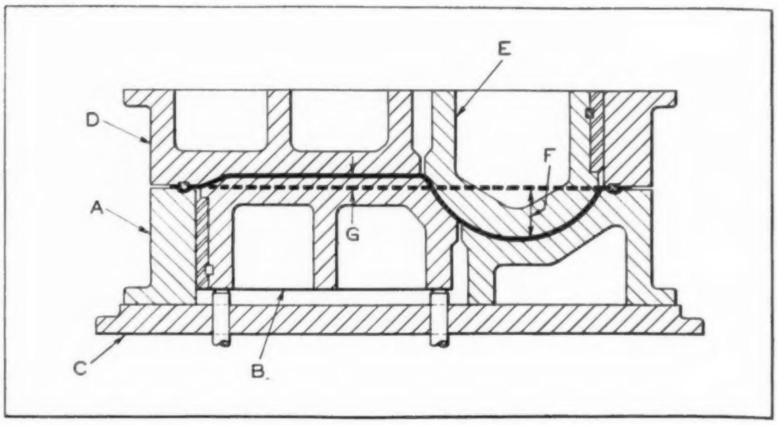


Fig. 9. Triple-action Drawing Die

Triple-Action Drawing Die

A drawing action in two directions can be accomplished in a triple-action press rather than with a combination air and toggle-action die. A triple-action die, Fig. 9, is used if air pressure is not sufficient to hold the blank while drawing. The blank is placed on the bottom die member *A* while the bottom-ram operated punch *B* is down on die-plate *C*. The upper die member *D*, attached to the outer ram, comes in contact with the blank and holds it as the inner-ram operated punch *E* moves downward to produce the downward-formed part *F* of the draw. Then, as the upper punch *E* dwells, the bottom punch *B*, operated by the lower ram through the medium of pins, moves upward to accomplish the upward-formed part *G* of the draw.

Triple-action dies are used less frequently than the other types, since few stamping plants are equipped with triple-action presses. A press of the single-action type is the first choice for drawing dies, with the double-action press second, and the triple-action press third. This order of preference is determined by the initial cost and operating speed of the equipment.

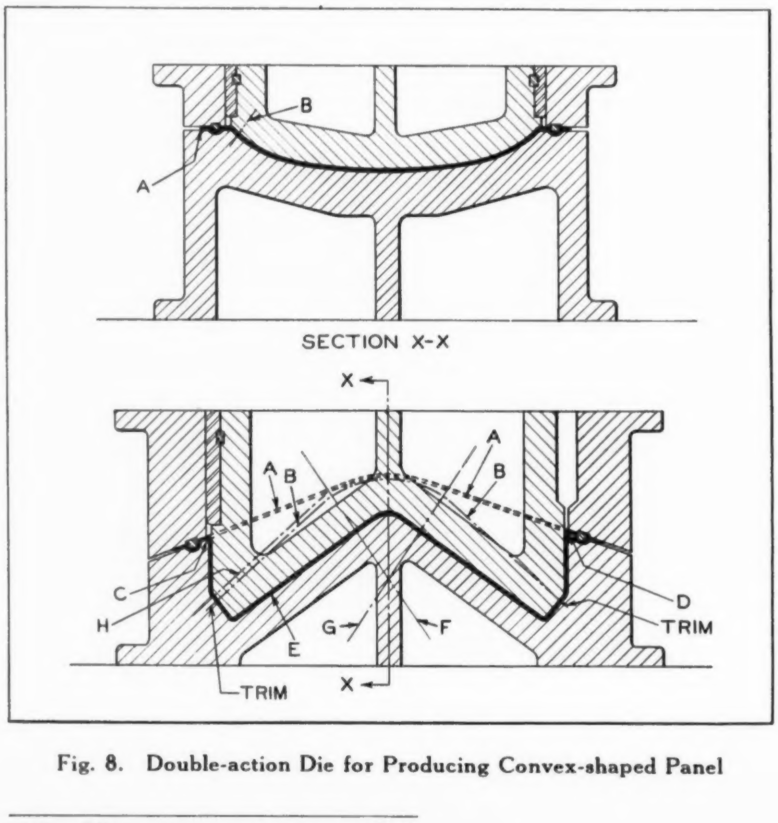


Fig. 8. Double-action Die for Producing Convex-shaped Panel

* * *

Equipment Salvage Becomes an Important Aid to Defense

An important aid to the National Defense Program is the prevention of serious interruptions to production caused by prolonged delays in obtaining replacements for worn or broken machine parts. Welding often offers a solution to this problem. The James F. Lincoln Arc Welding Foundation has collected statistics covering twenty-one pieces of equipment salvaged by welding, showing savings obtained through welded repairs. The average cost of salvage by welding was about 22 per cent of the cost of new parts.

One of the examples relates to a press for which the shop would have had to wait from ten to twelve weeks for replacement, whereas welded repairs restored the press in 56 hours, at 10 per cent of the replacement cost. In another case, the frame of an upsetting machine was repaired in 70 hours by welding, at a cost of only 6 per cent of replacement. It would have taken five weeks to replace the broken frame.

* * *

Resistance Welding Prize Contest

Papers to be entered in the prize contest sponsored by the Resistance Welder Manufacturers Association must be submitted to the American Welding Society, 33 W. 39th St., New York City, by August 31. Additional information regarding the contest will be furnished by the Society.

Some Applications of Hydraulic Operation to Machine Tools

A Number of Examples of Hydraulically Operated Equipment, Indicating the Wide Range of Possible Applications

THE use of hydraulic control and operation of machine tools, as well as of other classes of machinery, has greatly increased during recent years. The present article gives a number of examples of hydraulic equipment, and indicates the applications for which it is being used.

Internal honing, as performed on the hydraulic honing machines built by the Barnes Drill Co., Rockford, Ill., is accomplished by simultaneous rotation and reciprocation of the hone. The hone, equipped with abrasive stones of suitable grit and grade, is expanded in the hole to be honed by pressure exerted by a preloaded spring or by a hydraulically controlled device.

The helix angle of the path followed by the hone has an important effect on the accuracy of the finished hole. The included angle between the two helical paths followed by the hone in traveling in opposite directions is generally between 40 and 60 degrees. An important feature of the hydraulic honing machine is the provision for establishing the exact relationship between rotation and reciprocation necessary to secure the most effective "cross-hatch finishing pattern."

Hydraulic honing machines, operating in the manner described, are built in sizes covering a wide range of work. The smaller machines, for honing holes 5/8 inch in diameter and less, are of the vertical type, and the reciprocating movements are actuated by pistons operating in hydraulic cylinders; whereas the larger machines are of the horizontal type, equipped with a motor-driven variable-delivery hydraulic pump, which, in turn, drives a fluid motor. This motor is connected by gearing to a cable drum that transmits the regular reciprocating movements to the honing spindle head, or carriage, by means of a steel cable. The latter type of machine is made in various sizes, the largest having a spindle stroke of 76 feet and a capacity for honing cylinders or bores up to 30 inches in diameter.

The hydraulic system of a typical horizontal honing machine is shown diagrammatically in Fig. 1. This machine has a working stroke of 25 feet. The over-all length, including the work-supporting bed (not shown), which is bolted to the end of the machine bed at *T*, is 62 feet. The hydraulic system of this machine, including the variable-delivery pump *P*, fluid motor *F*, and the control valves, is made by Vickers Inc., Detroit, Mich.

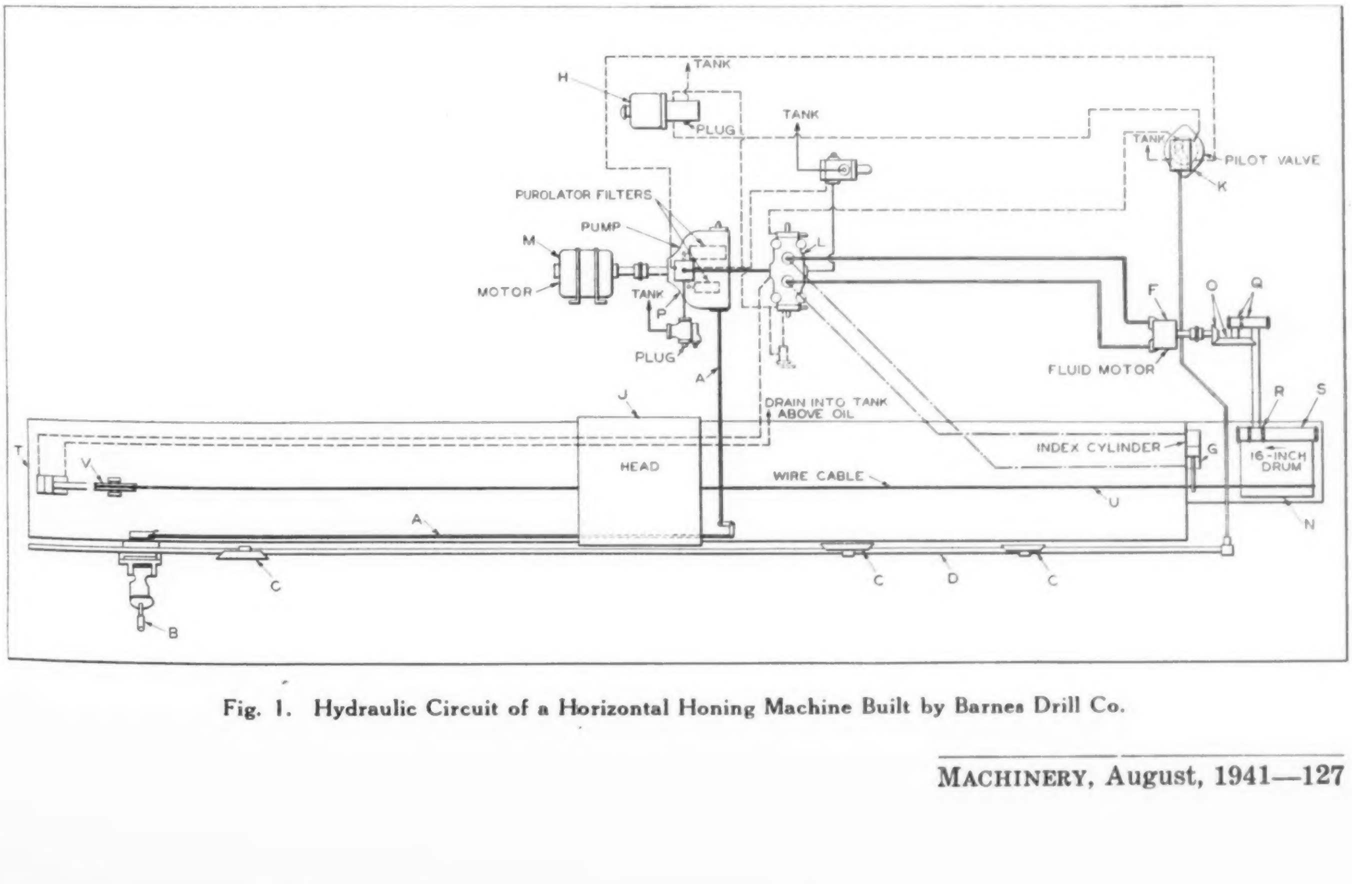


Fig. 1. Hydraulic Circuit of a Horizontal Honing Machine Built by Barnes Drill Co.

The variable-delivery pump *P*, driven by the electric motor *M*, furnishes power for reciprocating the carriage or head *J*. The speed of reciprocation is adjusted by linkage *A* and control lever *B*. This lever also starts and stops both rotation and reciprocation. The cams *C* on shaft *D* operate a pilot valve, which, in turn, actuates the four-way valve *L* to reverse the direction of oil flow through the fluid motor *F*, thus changing the direction of rotation of the cable drum *N*, which is driven by the fluid motor through bevel gears *O* and spur gears *Q*, *R*, and *S*, the ring gear *S* being attached to drum *N*.

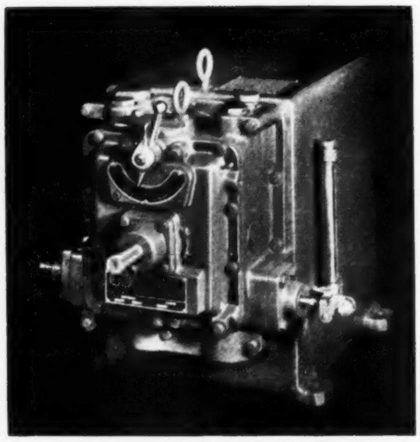


Fig. 2. Oilgear Fluid-power Feed with Oil Reservoir

The cylinder *G* is used to index the spindle at the ends of the strokes when performing parallel lapping operations on tubes after the rotating hone operation has been finished. The piston in cylinder *G* is caused to reciprocate by the four-way valve *L* at the same time that the reciprocating head *J* is reversed.

At *H* is indicated a push-button operated solenoid valve, which is so arranged that it permits the operator to withdraw the hone from the work for gaging purposes or for the removal of the work.

Fluid-Power Feed Units for a Wide Range of Machine Tools

Fluid-power feed units especially adapted for use on machine tools such as boring, drilling, reaming, milling, and cutting-off machines, lathes, and similar machines have been developed by The Oilgear Co., Milwaukee, Wis. One of these basic fluid-power pump units equipped with a regular oil reservoir is shown in Fig. 2. The basic fluid-power feed pumps are made in flanged, compact, self-contained units designed to be mounted on the sides of the machine. When mounted in this manner, the unit becomes an integral part of the machine. An oil reservoir is usually built into the machine structure. The feed unit may be provided either with a small casing that acts as an oil reservoir or with a base having a large oil reservoir and arranged for direct-connected motor drive.

Front or rear drive or both are available on all types of these power feeds. Any conventional constant-speed power source can be used. An electric motor, for example, can be connected to the driving shaft at either the front or back of the unit. A variable-displacement type of high-pressure pump is employed with provision that compensates for pressure and temperature changes. Rapid traverse for both directions of the cycle is provided by a built-in, large-volume gear pump.

The high-pressure relief valve, the rapid-traverse relief valve, the back-pressure relief valve, the feed-return resistance valve, and the main control valve are all built into the feed-pump unit, eliminating the need for auxiliary piping. Thus the installation on a machine tool is greatly simplified, it only being necessary to connect two pipe lines between the pump and cylinder. The simplicity of such an installation is shown diagrammatically in Fig. 3. Conventional load and fire type controls are suitable for operating these fluid-power feeds.

A complete line of these fluid-power feeds is made, including types with one adjustable feeding speed, two adjustable feeding speeds, delayed reverse mechanism, and fluid-power feeds arranged for remote control. The simplest types provide for rapid traverse forward, feed forward, neutral, and rapid reverse traverse. Other types are built to provide any or all of the following operating functions, in addition to the ones named: Feed reverse, coarse feed forward, fine feed forward, fine feed reverse, coarse feed reverse, and adjustable dwell at the end of the feeding stroke.

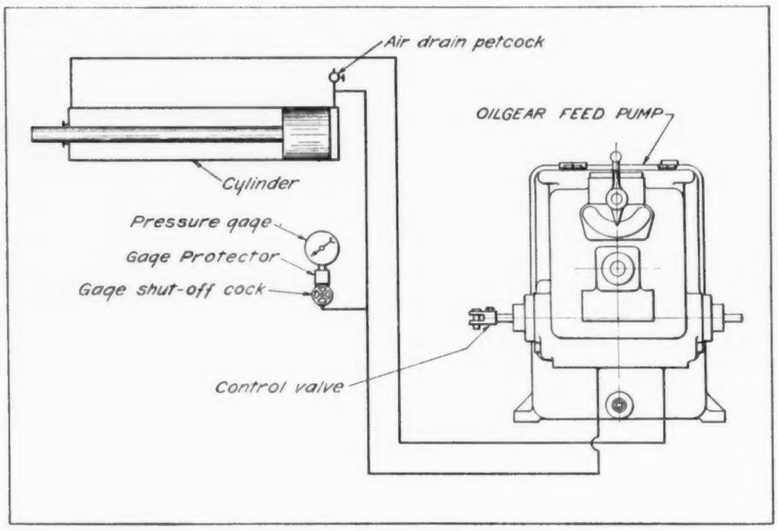


Fig. 3. Hydraulic Circuit Used with Unit Shown in Fig. 2 to Operate Feed Piston

The drive-shaft speed of these units is from 860 to 1140 R.P.M. The minimum feed delivery recommended ranges from 8 to 10 cubic inches per minute, and the maximum feed delivery from 260 to 350 cubic inches per minute. The rapid traverse delivery ranges from 3000 to 8000 cubic inches per minute. The maximum power required is 3 to 7 1/2 H.P. The maximum feeding and traverse pressures, respectively, are 1000 and 300 pounds per square inch.

American Society of Tool Engineers to Meet in Toronto

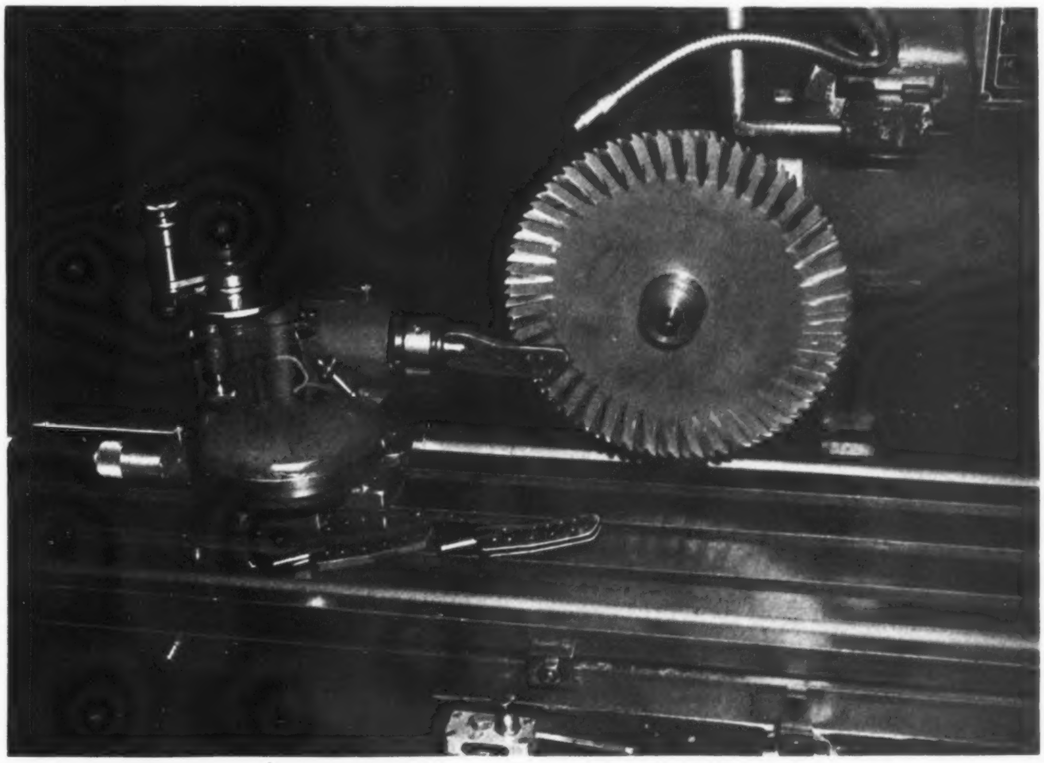
THE American Society of Tool Engineers, with headquarters at 2567 W. Grand Boulevard, Detroit, Mich., will hold its semi-annual meeting at the Royal York Hotel, Toronto, Canada, October 16 to 18. On the opening day, the technical sessions will be devoted to a consideration of machine tools for defense work. The utilization of old machine tools for defense work will also be dealt with. Since machine tools are useless without proper cutting tools, the second day's technical session will be devoted to "Getting the Most out of Cutting Tools." During the third day of the meeting, the shortage of trained men will receive consideration. This subject has been a major activity of the Society for some months. Through its Emergency Defense Training Committee, the Society has endeavored to help industry and the Government to expedite and improve the means for training workers in industry.

Another feature of the three-day session will be visits to some of the major industrial concerns in the Toronto area now connected with Canadian defense production. The Canadian plants have achieved remarkable results in this field.

Milling A Long Narrow Slot in Airplane Front-Rib Fittings

THE final step in a series of three milling operations performed in the machine shop of the Lockheed Aircraft Corporation, Burbank, Calif., to produce a long slender jaw in steel forged front-rib fittings for airplanes is shown in the accompanying illustration. A slot 3/16 inch wide must be milled to a length of 4 1/2 inches. The practice is to first employ a small-diameter cutter for milling a slot slightly less than the desired width for the full length. This slot is milled to a depth 1/16 inch less than the width of the piece. Then the cutter is withdrawn and the work indexed through 180 degrees to bring the unmilled side uppermost. The small-diameter cutter is now advanced again for milling the second side of the part to a depth within 1/16 inch of the center.

After number of parts have been milled in this way, the 12-inch cutter shown on the machine is substituted for the small-diameter cutter and the remaining stock in the center of the jaw is milled out to form the complete slot. A slight amount of stock is also removed from the surfaces already milled, so as to make both sides closely parallel. The machine employed for this operation is a Van Norman Machine Tool Co.'s regular ram type universal milling machine.



The Use of an Indexing Head Permits the Accurate Milling of a Long Narrow Slot in Airplane Fittings in Three Operations

Four Low-Cost Methods of Making Butterfly Valves

ALTHOUGH there are undoubtedly a great many ways of designing butterfly valves, the number of feasible types is limited when the element of cost is a predominating factor. In such a case, one of the four designs shown in the accompanying table would be used.

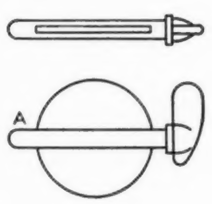
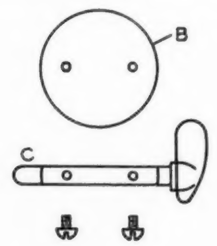
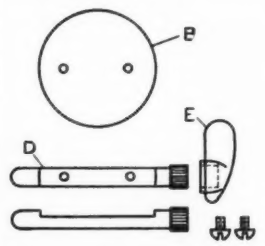
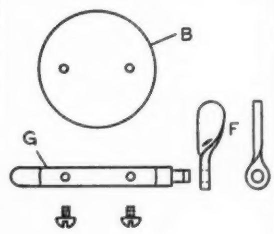
Each of these designs includes a lever type handle, which is superior in appearance to one formed by merely bending the end of a wire spindle to provide an integral handle. Except in Design 1, the disk is an inexpensive stamping. Designs 3 and 4 utilize a steel spindle made in a screw machine from rod stock. Steel parts would, of course, be subject to rust, and non-ferrous parts could be substituted to gain better corrosion resistance, but at higher cost. Zinc alloys would normally be used for the die-cast parts, because they are low in cost and easy to cast. The significant factors affecting cost and some of the advantages and disadvantages are listed briefly for each of the four designs in the table below.

* * *

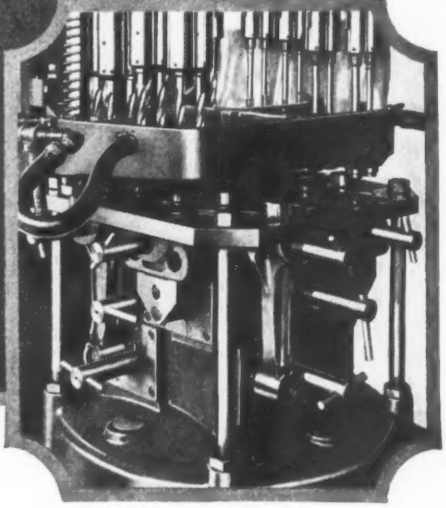
Aircraft Steel Welding Prize Contest to Close August 18

The Summerill Tubing Co., Bridgeport, Pa., is establishing a series of prizes to be awarded by the American Welding Society at its annual meeting, which will be held in Philadelphia, Pa., during the week of October 20. The prizes are for papers prepared with the object of advancing the art of welding aircraft steels, including tubing and other steel parts for tubular assemblies. To be eligible for this competition, it is necessary that all papers be submitted not later than August 18. For detailed information on the requirements, address the American Welding Society, 33 W. 39th St., New York City.

Comparison of Four Types of Butterfly Valve Design

Factors to be Considered	 Design 1	 Design 2	 Design 3	 Design 4
Parts needed	1 zinc-alloy die-casting *A*	1 stamped and pierced plate *B*. 1 zinc-alloy die-cast handle with integral spindle *C*. 2 screws.	1 stamped and pierced plate *B*. 1 zinc-alloy die-cast handle *E*. 1 spindle shaft *D*. 2 screws.	1 stamped and pierced plate *B*. 1 stamped, pierced, and formed handle *F*. 1 spindle shaft *G*. 2 screws.
Tooling required	Casting and trimming dies.	Blanking and piercing die for *B*. Casting and trimming dies for *C*.	Blanking and piercing die for *B*. Casting and trimming dies for *E*. Screw machine tools for cutting off, milling flat, cross-drilling, tapping, and knurling end.	Blanking and piercing die for *B*. Blanking, piercing, and forming dies for *F*. Screw machine tools for cutting off, forming, milling flat, cross-drilling, tapping, and knurling.
Machining required	None.	Tap two cored holes for screws.	Five screw machine operations only.	Six screw machine operations. One staking operation.
Assembly operations	None.	Drive two screws.	Press knurled end of shaft into cored hole of handle *E*. Drive two screws.	Press knurled shaft end into handle and stake to fasten against shoulder. Drive two screws.
Advantages	Low cost; all one piece; all non-ferrous (not subject to rust).	Cost moderate; only 2 pieces and 2 screws. Can be assembled in tube without joint.	Harder and stronger shaft than in Designs 1 and 2 and better fit in bearing hole unless shafts of Designs 1 and 2 are machined.	All low-cost steel parts adapted to rapid production.
Disadvantages	Applicable only at end or at joint of tube.	Shaft not hard and not precisely circular (unless machined); hence close fit may mean extra machining.	Steel parts may rust. Extra tooling, machining, and assembly required.	Steel parts may rust. Extra tooling, machining, and assembly required. Appearance of handle inferior to die-cast handle.

Design of Tools and Fixtures



Boring-Mill Fixture Designed for Boring Angular Hole through Pipe Flange

By JOSEPH WAITKUS, Wellsville, N. Y.

A recent request to provide supporting flanges for pipes installed in an angular or sloping position presented an interesting machining problem. The general design of the supporting flange and its position relative to the pipe are shown in Fig. 2. At first the intention was to lay out the necessary hole and then burn away the metal as near to the desired shape as possible. This was to be followed by a grinding operation or machining in a vertical shaper. However, this method proved too lengthy, and the fixture shown in Fig. 3 was, therefore, de-

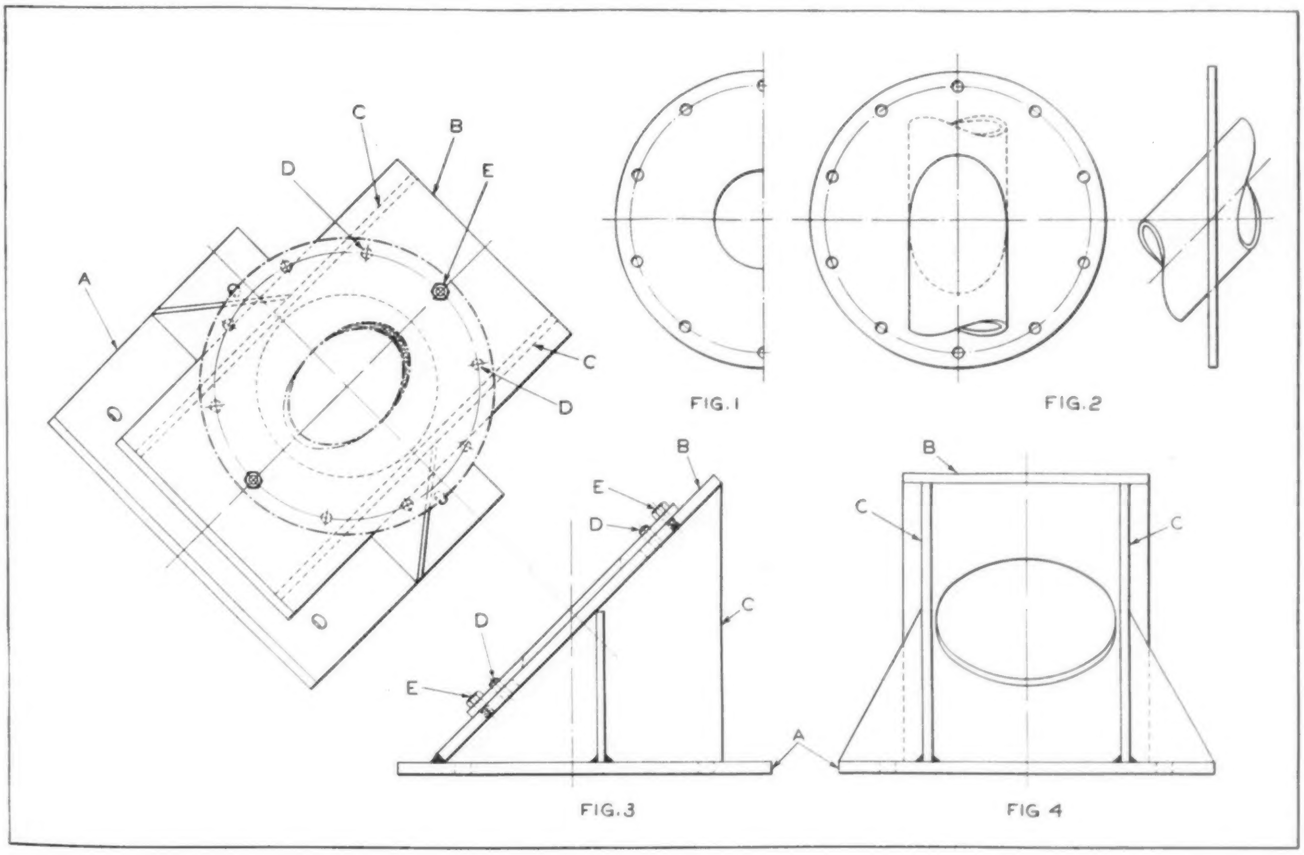


Fig. 1. One-half View of Flange as Prepared for Boring Angular Hole for Pipe. Fig. 2. Flange with Pipe Inserted at Angle. Figs. 3 and 4. Fixture Used on Boring Mill for Boring Angular Hole through Flange to Permit Inserting Pipe as Shown in Fig. 2

veloped for boring the hole to the desired size and at the required angle.

The fixture consists of a baseplate A to which a plate B and two ribs C are fastened by welding. The slope of plate B corresponds with the angle desired between the pipe and flange plate. Plate B is provided with four dowel-pins D and two bolts E. The plate to be machined is initially prepared as shown in Fig. 1. Holes are drilled around the edge and a hole is bored in the center which has a diameter equal to the small axis dimension of the ellipse to be machined. The flange plate is centered on the fixture by dowel-pins D, which are located to fit into the holes around the edge of the plate. Bolts E then serve to clamp the plate to the fixture.

The final machining operation consists of boring the hole in the center until the desired shape is obtained. A hole in plate B permits easy adjustment of the boring-tool depth as the machining progresses. Holes in baseplate A serve as a means for fastening the fixture to the boring-mill table. The fixture described made it possible to simplify a difficult job and resulted in a substantial reduction in machining time.

Plate Type Fixture for Milling and Drilling Operations

By F. SCRIBER

The efficient use of plate type fixtures is exemplified by the simply constructed fixture here illustrated. This fixture provides accurate location of the work and adequate clamping means for performing three milling operations, as well as a drilling operation, on the part shown by dot-and-dash lines at W.

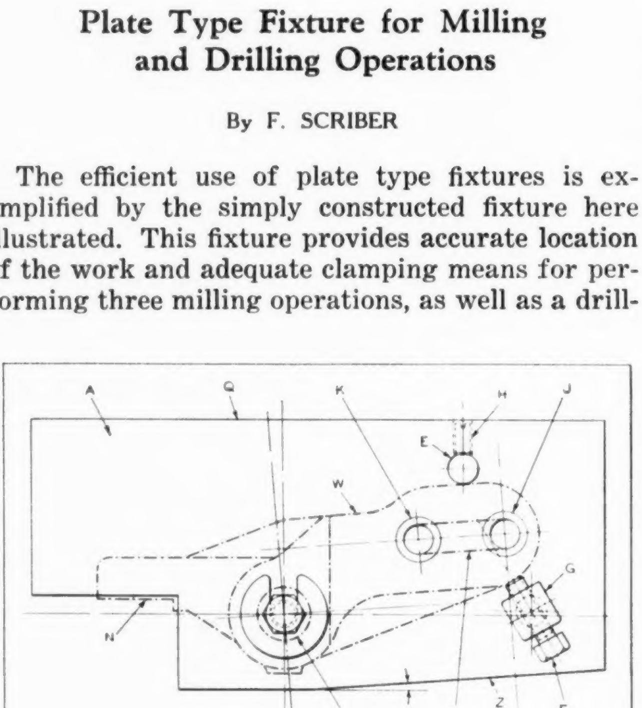


Plate Type Fixture Used in Performing Drilling and Milling Operations on Piece W

The base A of the fixture consists of a rectangular plate. The work W is located on plate A by a center hole that fits over stud B, and is clamped in place by means of a collar C. Collar C has one side cut away, so that it can be slid sidewise into position under clamping bolt D. There is also a locating pin E against which the work is clamped by set-screw F in block G, which is a force fit in the base of the fixture.

The screw at H holds locating pin E in place and permits it to be removed during certain operations. The two bushings J and K in base A guide the drill used in drilling a hole at each end of the elongated slot L. A knurled pin M locates the work by means of the slot end when machining the notched end of the work at N. The angular edge Z of plate A is used in locating the plate for milling the elongated slot L at angle X.

The operations performed on work W after the lower side R has been machined are as follows: Mill the surfaces of the work indicated at P; drill holes with the drill guided by bushings J and K; mill the elongated slot L; and mill the end step at N. Clamps are used to hold the fixture on the table while performing the machining operations.

During the first operation, which consists of milling the surfaces P, the fixture is mounted on a vertical milling machine. Location of the fixture is accomplished by placing the edge Q against a parallel held in the T-slot of the machine table. A large milling cutter mounted in the vertical spindle of the machine is passed over the surface to be machined, pin M not being in position in the work at this time. The work is located against stop-pin E and clamped by screw F.

For the second operation, that of drilling the two holes, the work is clamped in the fixture, which is then turned so that the work can be set on a block in the drill press, using surface P as a base and bushings J and K for guiding the drills.

After performing these operations on all parts of the lot being machined, the fixture is again placed on a vertical milling machine, setting it on the surface Y and, at the same time, locating it sidewise by means of the surface Z, which is set against a parallel in the T-slot of the machine. This locates the fixture at the correct angle X, so that the elongated slot L can be milled by inserting the slot-milling cutter in the hole at K and traversing the fixture lengthwise by means of the longitudinal table traverse until the cutter reaches the hole at J.

For the final operation, pin E is removed and pin M is used to locate the work by means of the end of the slot at J, the work being held in position on stud B by collar C. The final operation—milling the end at N—is then performed. At this time the fixture is clamped against an angle-plate with the edge Q resting against the table of the machine. This brings the fixture into a vertical

position, so that an end-mill held in the vertical spindle of the machine can be passed across the surface N by employing the cross traverse of the machine.

Surface-Grinding Face of Connecting-Rod Cap Joint to Duplicate Original Error

By STANLEY PORRITT, Philadelphia, Pa.

When a piece of work is supposed to be square and is found to be in error, it is usually easy to set it up and machine it square. However, if the work is known to be out of square some undetermined amount and this error must be duplicated when working on the piece, a great deal of time can be wasted in finding the amount of the error and in duplicating it.

A case of this kind was encountered in repairing connecting-rods in the plant of a well-known builder of small Diesel engines. Such rods as fail to pass final inspection because of errors in the big end can usually be repaired by grinding several thousandths inch from the face of the cap and then rehoning the bore. In the case in point, the rod forgings are rough-machined and then split with a milling saw. They are then bolted tightly together and finish-machined, no attention being paid to the squareness of the faces other than to obtain ordinary commercial milling accuracy.

When returned to the grinding department for repairs, the problem is to take off 0.010 inch or more evenly over the entire face of the cap. Since the rod bolts are a tight fit for alignment purposes, taking more off one half of the cap face than the other would result in binding and bending the bolts when the cap was pulled up tight. Since the thickness of the rod at the big end is held to close limits, it is imperative that an even thickness be taken off in a lateral direction, so that the alignment of the parallel sides of the rod and cap will be maintained.

The former method of doing this job was to clamp the cap to an angle-plate and level the two halves of its face with an indicator, after which the angle-plate was shimmed up one way or the other to bring the face of the cap level in the other direction.

A great saving in time was accomplished by making two parallels with circular edges, as shown at P in Fig. 1. These were centered at the ends and turned and ground straight and parallel. One parallel was drilled and tapped for clamping bolts, as shown, the other being drilled to suit the body size of the bolts. In use, the cap W is laid face down on the magnetic chuck and the two parallels P are clamped to the sides of the cap while resting on parallels 1/8 inch thick, as shown in Fig. 2. This causes the face of the cap to project 1/8 inch above the circular parallels when the assembly is turned over, as shown in Fig. 3, for grinding surface S.

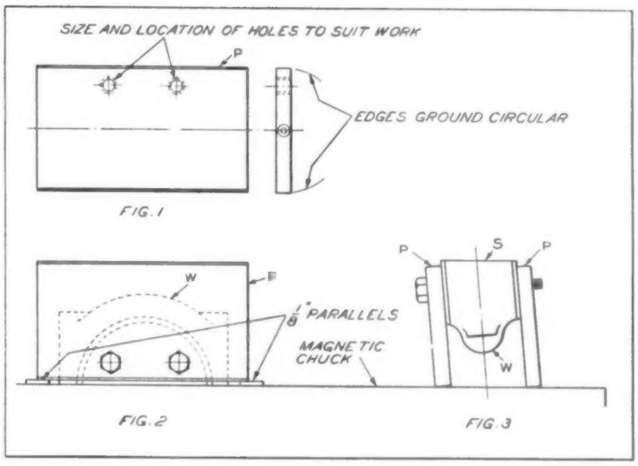


Fig. 1. Cylindrical-edged Parallel P. Fig. 2. Method of Setting up and Clamping Parallels P to Work W. Fig. 3. Work and Parallels Mounted on Magnetic Chuck for Grinding Surface S without Changing its Angular Position with Respect to Sides or Axis of Work

In this way, the face of the cap and one edge of the parallels are brought into correct relation, so that when the parallels are turned over, the face of the cap is parallel with that of the magnetic chuck, regardless of the fact that it is not at right angles with the sides of the cap. There are many places where similar parallels could be used to advantage.

* * *

National Metal Congress and Exposition

The National Metal Congress and Exposition, to be held in Philadelphia, Pa., October 20 to 24, promises to be a more important event than ever before. The exposition, which will be held in the Philadelphia Commercial Museum and Convention Hall, will probably be larger than any previous metal exposition. The space sales at the present time are already 10 per cent ahead of last year. The importance of metals in the National Defense Program will be the general theme of the exhibits. It is understood that many of the exhibitors will feature new products and methods now being employed in defense production plants.

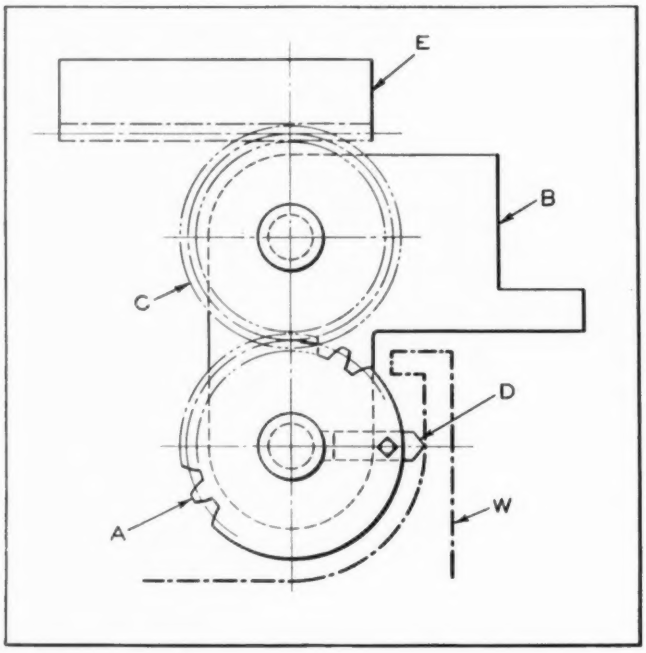
The National Metal Congress, which is held in conjunction with the exposition, is participated in by the American Society for Metals, the American Welding Society, The Wire Association, and the Institute of Metals Division and the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers. The technical sessions will be held in various Philadelphia hotels during the exposition week.

* * *

Patterns for manganese steel castings should be constructed especially for casting that metal, because the shrinkage of manganese steel is 5/16 inch per foot—much more than for ordinary castings.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Radius-turning Tool Used on Vertical Turret Lathe

Special Tool for Radius-Turning Operations on Airplane Motor Crankcases

A special tool developed by the writer for large radius-turning operations on a vertical turret lathe is shown diagrammatically in the accompanying illustration. This tool has been found useful in performing large radius-turning operations on crankcases and superchargers for airplane engines.

Segment gear A is mounted on holder B in mesh with intermediate gear C. Square tool bit D is fastened to gear A by a set-screw. Holder B is fastened to the side tool-holder of the vertical lathe. Rack E, which is fastened to the vertical turret head meshes with intermediate gear C. By feeding rack E sidewise, tool bit D describes a circle, turning work W to the required radius.

ERNEST LEBOIS
Tool and Method Division
R. Hoe & Co., Inc., New York City

Cross-Hatching Kink

Much time can be saved in producing cross-sectional drawings by making the cross-hatch lines free-hand with a soft lead pencil. Excess lead left on the drawing by the pencil can be removed to avoid smearing by simply wiping the drawing off with a soft rag. Code letters can be used to indicate the various materials.

Oakland, Calif. M. JACKER

Simple Arrangement for Drawing an Ellipse

The drawing of an ellipse is somewhat of a task for the draftsman having only ordinary drawing instruments. However, with the simple trammel equipment shown in the accompanying illustration, it is an easy matter to draw an ellipse to any desired size.

In the trammel arrangement shown, AB equals one-half the major axis and BC equals one-half the minor axis of the ellipse to be drawn. In operation, the blunt legs A and C of the trammel are kept in contact with the inside of the square S while the pen or pencil at B traces one-fourth of the ellipse.

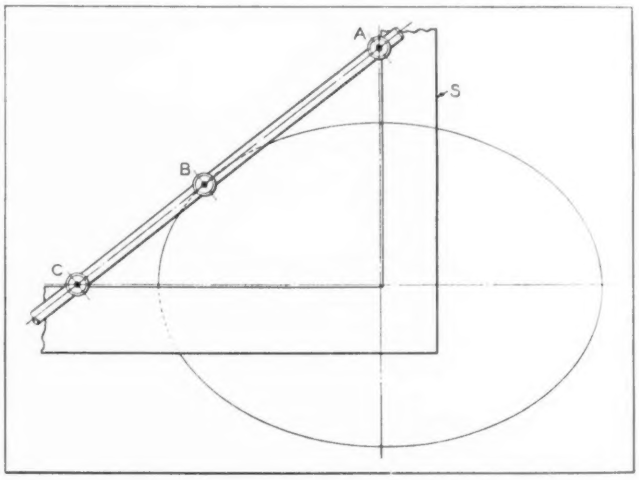


Diagram Showing Method of Using Trammel and Steel Square for Drawing an Ellipse

Bradford, Pa. R. L. AUSTIN

* * *

According to E. O. Shreve, vice-president in charge of sales of the General Electric Co., Schenectady, N. Y., 15,000,000 American men and women are working today at jobs that did not exist in 1900 and that are the result of research and invention in industry. This is another indication of how industry creates jobs.

Electromagnetic Feeler-Gage Control

Tracing Steep Contours in Die-Sinking, and the Automatic Control of Contour Milling—Third of a Series of Articles

METHODS of automatic electric control of feed motions in die-sinking machines were described in an article published in September, 1940, MACHINERY. The present article deals with the "stepless" tracing of steep contours and the use of electric control for automatic contour milling.

When contours have an inclination of more than 45 degrees, the feed control movement described in the previous article is not applicable, as the feeler encounters no appreciable resistance in the axial direction and tends to slide off sidewise. A special arrangement of the horizontal gage head is adopted in such instances, so that even steep slopes can be followed without steps. Only sharp corners and continuously changing slopes, such as curved surfaces, need be traced step by step.

To cut down expensive, time-consuming operations during which no actual machining is done, the steps for adjustment to change in contour must be as small and as rapid as possible; thus, the regulators are always short-circuited whenever the feeler is not in contact with the master, so that its movement toward and away from the surface of the master takes place at the maximum speed of the feed motor.

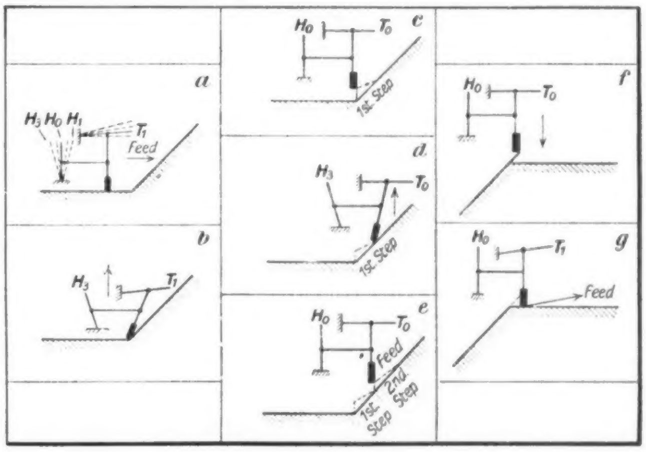


Fig. 9. Steps Taken in Adjustment of Feeler to Changes in Contour Slope

Depending on the direction in which the feeler is deflected sidewise, the armature of the horizontal head takes up the position H_1 or H_3, as seen in view *a*, Fig. 9, causing the same Thyratron valve to be ignited. The anode circuit of the latter contains two small relays which are connected to a double-way rectifier, so that one of the relays operates in the position H_1 only, and the other in the position H_3 only.

The two control currents supplied from the small relays are directed in such a manner that when tracing ascending contours, where the feeler pin is deflected in a direction opposite to that of the feed, the feeler pin is always withdrawn vertically from the model, while when the feeler pin is tracing descending contours and is deflected in the direction of the feed, it is withdrawn horizontally. Thus, different controls are applied, depending on whether steep projections or recesses are to be traced, with the result that tracing and milling can be accomplished automatically in either direction without any idle time.

Whenever the feeler is clear of the model, it tends to advance toward it. When tracing a horizontal surface, the in-feed movement is stopped after contact has been made, and the horizontal feed movement started. Upon striking a vertical projection, the feeler is deflected, as shown at *b*, and immediately interrupts the horizontal feed, while the feeler is withdrawn axially, as seen at *C*, until it is clear of the projection. The feeler pin then returns to normal from its deflected position, and the control is again operated for axial advance of the feeler toward the projecting edge of the model as at *d*; succeeding steps are then taken as indicated at *e*. To prevent damage to edges due to skipping or dancing effects similar to those that may occur in tracing steep contours or the actual sliding of the feeler off the edge, its axial advance is retarded until the horizontal feed has moved it forward sufficiently to insure clearance of the edge. This retardation time can be adjusted from 0.1 to 1 second.

The operation of the feeler, in this case, is as follows: When the feeler clears the model, as at *f*, the armature of the in-feed gage head is in the position T_0; therefore, the feeler advances toward the model, and when it strikes the latter, the armature is deflected into the position T_1 as shown at *g*. Thus, the corresponding Thyratron valve is ignited, the advance movement is stopped, and the horizontal feed movement started, causing the feeler to travel over the horizontal surface of the model.

On striking the vertical projection, the feeler pin is deflected sidewise, displacing the armature of the horizontal gage head from the position H_0 into the position H_3. As a result, the corresponding Thyratron valve is ignited, and the horizontal movement of the feeler is stopped instantly, while at the same time, the feeler is withdrawn. Moreover, a condenser which is connected to the nega-

tive grid voltage of the control valve is discharged —that is to say, short-circuited—for a brief period.

When the feeler has cleared the vertical projection, the armatures of the horizontal and in-feed gage heads are in the positions H_0 and T_0, respectively, and the condenser is no longer short-circuited, so that it can be charged again. Due to the drop in voltage resulting from the charging current, the negative-grid voltage is reduced, and the control valve T_1 is caused to ignite, so that no in-feed movement can occur during the time the horizontal feed is taking place to insure clearance of the edge. As the charging of the condenser is completed, normal conditions are restored again. If, during the condenser-charging period, the feeler, in moving forward horizontally, runs against an angular projection, the condenser discharges instantly, so that the feeler is withdrawn from the model. The small amount of stock left when the cutter jumps over edges is removed during the subsequent advance of the cutter toward the work.

Regulating the Movement of the Feeler

Four units mounted on the same shaft are used to control the advance movements of the feeler, withdrawal of the feeler, and the resulting working movement. This four-unit drum is coupled to the regulating set and driven by the same motor, as shown in Fig. 10.

The four segments of the first unit are connected to four corresponding automatic switches controlling the advance movement of the feeler, which may be right, left, up, or down, depending on the position of the feeler relative to the work. When the feeler is clear of the templet, the resting contacts $H_{1/3}$ and $V_{1/3}$ are closed, so that one of the four switches is operated, depending on the position of sliding contact A.

In the position shown, the feeler is moving toward the templet in the direction from left to right. Either contact $H_{1/3}$ or $V_{1/3}$ is opened when the feeler comes in contact with the work, so that the advance movement is stopped, and at the same time, a short-circuit switch is operated through a

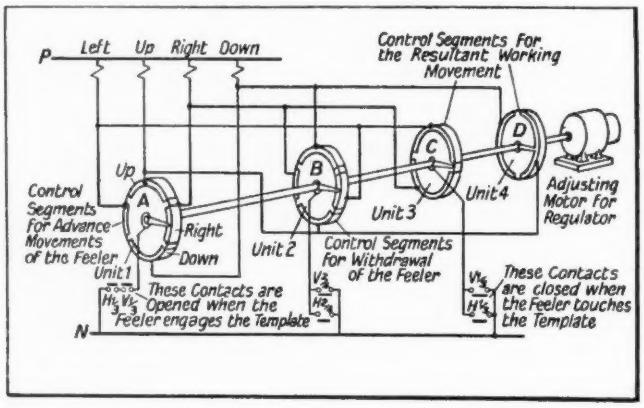


Fig. 10. Directional Control Arrangement for Feeler and Work Feed Movements

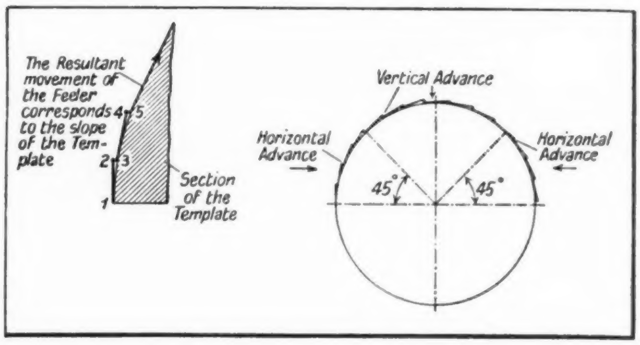


Fig. 11. Diagram Indicating how Feeler Automatically Traces the Contour of a Templet

second working contact $H_{1/3}$, so that the feeler moves in the resultant working direction 1 to 2, Fig. 11. As the regulator for the horizontal feed motor is in the "out" position, while that for the vertical feed motor is in the "high speed" position, the feeler moves upward at a rate adjusted by the general regulator. Subsequent regulations cause the resultant movement of the feeler to correspond with the slope of the templet.

When the feeler comes in contact with a projection, the four segments of the second unit control the withdrawal of the feeler in opposite directions from the advance movements. This withdrawal starts, when either of the working contacts $H_{2/4}$, Fig. 10, is closed, after the corresponding resting contacts $H_{1/3}$ or $V_{1/3}$ have been opened. Thus, it will be seen that before the armature of the horizontal head swings to either of the positions H_2 or H_4, it must first pass through the position H_1 or H_3, so that the contacts $H_{1/3}$ must be open prior to closing the working contacts $H_{2/4}$. Then the feeler withdraws and moves up or down, or left or right, depending upon its position relative to the templet.

The third and fourth units of the control drum determine the four main directions for the resultant movement of the feeler. Whenever the resultant working movement has been switched on, the sliding contacts C and D of the units 3 and 4 are connected to the line as the working contacts $V_{1/3}$ and $H_{1/3}$ are closed. In the position shown in the diagram, the motor switch for the right-hand feed movement is operated by the sliding contact C after the control drum has been rotated clockwise, as mentioned previously, so that both feed motors run together at the speeds adjusted by the regulator as soon as the feeler comes in contact with the templet.

The resultant working movement is a combination of either right or left movement, controlled by the third drum unit, and up or down movement, controlled by the fourth drum unit. As the control drum rotates, the relative speeds of the up or down motor and the right or left motor are changed, so that the direction of the working movement is changed by a certain angular amount after each step until the direction conforms to the slope of the contour. When this occurs, the contour is subsequently followed without steps.

Adjustment in Direction of Feeler Approach

If the contour changes to such an extent that the direction of the resultant working movement no longer corresponds to the slope of the templet, the motors are regulated again. Thus, when the feeler reaches the 45-degree radial, Fig. 11, the direction of its advance and withdrawal movements is changed, since the sliding contact *A*, Fig. 10, has meanwhile left the segment "right" and passed over to the segment "down," while the sliding contact *B* is connected to the segment "up." The feeler, therefore, approaches the model in a vertically downward direction whenever it leaves the contour.

From the 45-degree to the 90-degree line, Fig. 11, tracing takes place in the same manner as over the first section. As the feeler reaches the apex of the templet, the sliding contact *D*, Fig. 10, leaves the "up" segment and moves on to the "down" segment. This results in a change in the working direction, the angle depending on the angle of clockwise rotation of the regulator and control drum. In this way, also, projecting, sharp-pointed edges of contours can be traced automatically, a special control system being provided for this purpose which comprises two additional segmental contact rings mounted on the control drum and driven by the same adjusting motor.

For contour-milling, as well as for die-sinking by successive traverses, either horizontally or vertically, the position of the control drum and regulator set, and therefore, the direction of the resultant feed movement, is indicated by a remote-controlled instrument known as the "Eltascope." The baseplate of this instrument carries twenty-six holders with incandescent bulbs arranged in a circle, and there are a corresponding number of sectors. By means of contacts on a contact plate in the regulator set, the bulbs are so controlled that the sector that corresponds to the position of the regulator or control drum is caused to light up, thus indicating the direction of feed movement. If, during a die-sinking operation, the horizontal feed movement of the feeler pin is reversed from one line to the next one, the indicator is simultaneously reversed in such a way that the direction of the actual feed movement is always shown by the illumination of a bulb on the corresponding sector. The same applies to the vertical feed movements during die-sinking operations.

By means of special relays, protection is provided against damage due to breakage of feed wire, excessive deflection of the feeler, or unbalance in the Wheatstone bridge, due to a break in the line. A bimetal relay in the spindle motor affords protection against overloading the cutter.

* * *

Early in August, the General Electric Co. paid approximately $2,373,000 as profit-sharing payments for the first six months of this year to about 68,000 employes.

An Example of Rapid Factory Construction

Production of fluorescent lamps is just being started in a new Westinghouse factory near Fairmont, W. Va., built on a site that less than five months ago was a snow-covered mountainside. Beginning in March this year, this ground was leveled and the construction crew erected 710 tons of structural steel in 76 hours of working time. In less than five months, this $3,000,000 windowless air-conditioned manufacturing plant, covering nearly five acres of floor space under one roof, has been completed. The ultimate output of this plant will be 200,000 fluorescent lamps a day.

The excavation work, on account of the hilly location where the plant is located, involved handling 260,000 cubic yards of material, varying from hard rock to soft clay. The site was cut by two ravines of considerable depth, both of which were filled level with the surrounding ground. The main plant is a structure approximately 225 feet wide by 900 feet long. It is planned later to erect a glass factory on the site, adjoining the new lamp plant.

Since it is extremely important, in the manufacture of fluorescent lamps, that there be no dirt or dust in the air, the regular air-conditioning system is supplemented by Westinghouse Precipitron electrostatic air-cleaning cells, which remove approximately 90 per cent of all air-borne particles before the incoming air is circulated in the plant. The shipping and receiving rooms are provided with air curtains consisting of double doors with air chambers between to help keep all dust out of the plant.

The method of cooling the air used in the air-conditioning system is quite unusual. The air is cooled by water which is pumped from an abandoned and sealed coal mine 1800 feet away and 150 feet lower in elevation than the plant. In this mine, the water is at a constant temperature of about 55 degrees F., and hence is suitable for cooling the air to the required temperature.

* * *

Famous Train to be Streamlined

The E. G. Budd Mfg. Co., Philadelphia, Pa., has just started the building of thirty-two streamline cars for the new Empire State Express of the New York Central Railroad, which has maintained service as one of America's famous trains between New York and Buffalo for half a century. The inauguration of the new streamliner cars, in fact, will celebrate the fiftieth year of operation of this train, which is intended to be made the last word in modern design and luxury in railroad travel. The train runs on the fastest daylight schedule between New York, Buffalo, Cleveland, and Detroit. The first of the cars will be completed within three weeks, and the delivery of the completed train is scheduled for the early fall.

Explosive Rivets Speed Aircraft Production

By D. L. LEWIS, Jr.
E. I. du Pont de Nemours & Co.
Wilmington, Del.

AN explosive rivet, now being manufactured in commercial quantities by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., may prove an important factor in speeding American aircraft production and in simplifying design. This rivet, which is of an entirely new type, has a high explosive secreted in a cavity at the end of the shank. Heat applied to the rivet head by an electric gun detonates the charge. The resulting explosion expands the charged end of the shank, thus forming a "blind" head and setting the rivet. The explosive charge is controlled so accurately that the expansion it effects may be held within limits of 0.020 inch.

The whole riveting operation is thus performed from one side of the work, with greater ease and speed than is possible by any mechanical means now being used in aircraft factories. The importance of this development is fully realized only when it is considered that there are 800 or more fastening points in an all-metal pursuit plane, and as many as 10,000 in the largest all-metal bomber, that are accessible from only one side. The rivets can be installed by one workman at the rate of fifteen to twenty a minute, when they have once been put in place. The riveting gun or iron weighs less than 5 pounds, and the rivets themselves weigh only about one-fourth as much as the generally used blind fasteners of mechanical design.

Gang riveting machines, automatic hole-punching, and rivet-driving devices, and the occasional replacement of rivets by high-amperage spot-welding have tended to simplify the fastening problem. However, these methods, together with the driving of conventional rivets individually by two-men crews, usually at the rate of two to three rivets a minute, are applicable only in assemblies that permit access to both sides of the work.

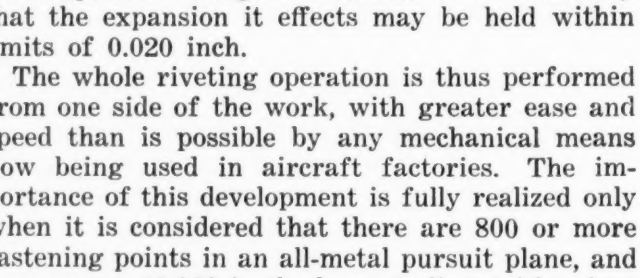


Fig. 1. Reproduction of Section Photograph, Showing Explosive Rivet before and after Expansion

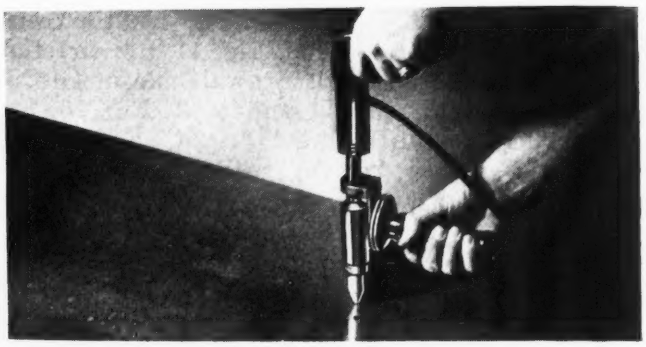


Fig. 2. Applying Riveting Iron to Explosive Rivet to Detonate Explosive Charge which Expands Rivet End

The explosive rivet is shown both in the original and installed conditions in Fig. 1. Prior to installation, the rivet is similar to one of the solid type, except for the cavity, which is concentric with the shank and open at the shank end. The cavity holds the small explosive charge which, when heated to a certain temperature, detonates and expands the shank end uniformly without cracking. The shape of the rivet after expansion is shown in the view to the right. The explosive employed requires no wadding or confinement.

The heat necessary to detonate the charge is supplied by the specially designed electric tool shown in Fig. 2. This tool has a silver tip, and is known as the "du Pont riveting iron." The method of applying the iron to the die-formed head of the rivet is shown in the illustration. Only 1 1/2 to 2 1/2 seconds elapses from the time the riveting iron is applied until expansion takes place.

The explosive rivets now being manufactured are made from an aluminum alloy and are available in varying diameters and sizes to meet structural requirements. They are of the modified brazier-head and countersunk types, the latter permitting the flush-riveting required by modern high-speed planes. The rivets are installed in the "age-hardened" condition, and do not require refrigeration after heat-treatment, as is the case with solid rivets of the same alloy. The shear and tension characteristics of these rivets are approximately the equivalent of driven rivets of the type most widely used. The explosive rivets are safe, and can be used without fear of serious injury. However, they should be handled with reasonable care. Numerous safety tests have indicated that they will not detonate en masse, and are quite insensitive to shock and friction. In addition to their use in aircraft, it is believed that explosive rivets may find many applications in other industries, and that they can be manufactured in still larger sizes and in other metals, including steel.

Properties and Application of Manganese Steel

MANGANESE steel is an alloy principally of manganese and iron, with carbon, as usual, a constituent. This steel generally contains from 10 to 16 per cent manganese, the customary content being 13 per cent. Steels containing from 1.5 to 2 per cent manganese are sometimes referred to as manganese steels, but these steels do not have the same properties as those with a higher manganese content, and in the steel industry are not usually referred to by that name. Hence, in speaking of manganese steel, steel with the higher manganese content is referred to.

The unusual properties of manganese steel were described by Hadfield in England in 1882. The steel was introduced in America in 1892, and first produced in the electric furnace in 1919. It is often referred to as "the toughest steel known."

In a recent publication, the American Manganese Steel Division of the American Brake Shoe & Foundry Co., Chicago Heights, Ill., calls attention to the outstanding properties of cast, heat-treated manganese steel. These properties are high tensile strength and ductility, unusual toughness, and noteworthy work-hardening properties. While the initial hardness of manganese steel—from 185 to 200 Brinell—is not much greater than that of ordinary cast steel, the surface hardness will increase greatly under repeated impact, reaching a maximum of 550 Brinell. The surface hardness is continually maintained as long as the metal continues in service, while the body metal retains its original toughness.

As cast, before heat-treatment, manganese steel is as brittle as cast iron, but after heating and quenching, it has a toughness greater than that of any other steel. As cast, manganese steel is about as abrasive-resistant as tool steel or chilled cast iron, but under impact and abrasion the metal structure becomes increasingly hard in proportion to the severity and repetition of the impact.

Because of the high tensile strength and unusual ductility of manganese steel, which is the secret of its toughness, it is able to adequately resist shock stresses and yet to yield or deform under heavy impacts rather than break. After heat-treatment, manganese steel in bar form can be bent double, when cold, without fracture. Likewise, castings in service will deform before fracturing.

It is possible to forge manganese steel, but experience is necessary to avoid ruining the metal. After forging, it is essential to reheat-treat the metal, using the same heat-treatment as was used for the original casting. After forging or welding, manganese steel should be heated uniformly throughout to 1850 degrees F. and quenched in water. A temperature of 1850 degrees F. is indicated by a light orange color.

For building up the surface to compensate for wear, manganese steel can be welded with nickel-manganese steel welding rod, and for repairing fractures, either nickel-manganese steel or stainless-steel rod may be used.

For certain applications where the surface is highly abrasive with little or no impact, the wearing life of manganese-steel castings is increased by hard-surfacing. For such purposes, an Amsco No. 459 hard-facing rod is recommended; this can be applied without difficulty by a torch or electric arc.

Manganese steel cannot be cut with ordinary cutting tools. It can be cut with special grades of steel and with cemented-carbide tools, but special technique and equipment are required. Machining in this manner is expensive, and is only used when, for some reason, grinding cannot be employed. Practically all machining on manganese steel is done by grinding.

In making manganese-steel castings, patterns used for ordinary iron or steel castings should not be employed unless great tolerances in the dimensions of the castings are permissible. Manganese steel shrinks 5/16 inch to the foot in cooling, while ordinary cast iron and steel do not shrink more than 3/16 to 1/4 inch. Hence, patterns are usually constructed especially for manganese-steel castings.

Manganese steel is distinguished from other iron and steel by the fact that it is almost completely non-magnetic. All steels become non-magnetic above the critical temperature range. Manganese steel is as non-magnetic at ordinary temperatures as at a temperature of 1850 degrees.

Manganese steel has its greatest application where the metal must resist abrasion, together with heavy repeated impact stresses. For such applications, manganese steel resists breakage much better than ordinary steel, and usually has from two to ten times the wearing life of ordinary steel. It should be noted, however, that only for a limited time can manganese steel be used in excessively hot places. It should never be used when the temperature exceeds 650 degrees F. With an addition of from 3 to 5 per cent nickel and less carbon content, manganese steel can be used safely at temperatures up to 1100 degrees F.

There are a number of special alloys of manganese steel, such as those containing chromium and molybdenum, that have an even higher yield point and tensile strength than the regular man-

ganese steel. When nickel is added, these alloys have higher heat resistance and can be welded more safely. However, they are considerably more expensive to make, and while they are more durable than regular manganese steel, they are usually available only at a higher price.

Among the equipment for which manganese steel finds its greatest application may be mentioned machinery for the cement, clay products, coke and iron, dredging and excavating fields; it is regularly used for foundry, glass-making, mining, quarry, and steel mill equipment.

Sabotaged Engines Repaired without Removal from Ship by the Use of Bronze-Welding

IN spite of severe damage to the main engines and vital control parts of the German and Italian cargo vessels that the United States Government took over last April, the repair work has been so speeded up that a number of these ships are about ready to resume service. The damage done and the efficient manner in which the repairs were made are evidenced by the three accompanying photographs, taken on the Italian freighters *San Giuseppe* and *Vittorin*. On each ship, large U-shaped sections had been broken out of the walls of the intermediate pressure cylinders just below the steam ports. As shown in Fig. 1, bronze-welding made possible the repair of these main engines without requiring their removal from the ships.

After the new sections were cast to fit the contour of the breaks, they were bronze-welded in place. To minimize contraction stresses on cooling, the operator started at the bottom of the U, as shown in Fig. 2, and alternated from one side to the other every 3 inches, first half filling the vee, peening the deposited metal, and then completing the weld and peening. One of the completed welds, after a rough-boring operation on the cylinder, is shown in Fig. 3. Other parts on these ships that were repaired by bronze-welding included main engine valves, cylinder heads, fire-pumps, air-pumps, feed-pumps, foundation columns, and steering engines. The repair work on these ships is being carried out under the supervision of the Maintenance and Repair Division of the United States Maritime Commission.

Fig. 1

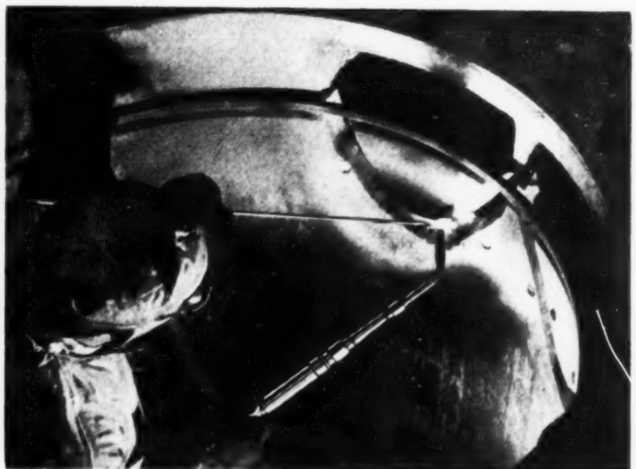


Fig. 2

Fig. 3

Two Italian Ships were Damaged by Having Large U-Sections Cut out of the Intermediate Engine Cylinders just below the Steam Ports. Bronze-welding Enabled Repairs to be Made, as Shown in Fig. 1 (Above Left) without Removing the Engine. Fig. 2 (Above Right) Shows a Section Cast to the Proper Contour of the Break being Welded in Position. The Finished Weld is Shown in Fig. 3 (Left) after a Rough-boring Operation

Does the Wagner Labor Act "Diminish Disputes"?

THE results of the Wagner Labor Act, anticipated by many, have now become clear and obvious. The *New York Times*, in a recent editorial, from which we quote, has made a concise analysis of the working of the Act. Says the *Times*:

"The officially declared purpose of the Wagner Act is 'to diminish the causes of labor disputes . . . obstructing . . . commerce.' The question may well be raised, however, whether the Wagner Act, instead of diminishing strikes, does not constitute a strong encouragement of them. The Act defines an employe as including 'any individual whose work has ceased as a consequence of, or in connection with, any current labor dispute.' This means that strikers remain employes and cannot be discharged as long as the 'labor dispute' continues.

"Wholly apart from the question of union recognition for collective bargaining—the sound principle of which the Wagner Act was designed to protect—consider the position in which the clause just quoted puts an employer. If his workers strike, if they begin mass picketing of his plant, and by intimidation or violence prevent non-strikers from going to their jobs, the employer has no protection or redress under the Wagner Act. Nor even in such circumstances do the strikers lose their legal right to remain his employes. If, even should the strike be clearly unjustified, the employer attempts to employ workers in place of the strikers, he is accused of 'strike breaking.'

"But if he does, nevertheless, succeed in spite of these obstacles in replacing the strikers, the strikers are still, under the Wagner Act, his employes. There is no legal limit whatever on the time that they remain so. Years afterward the Labor Board can rule that the strike was the result of an unfair labor practice on the part of the employer, or that he used discrimination in replacement. If the officially aggrieved strikers have not meanwhile obtained 'any other regular and substantial equivalent employment' the Board can order them reinstated with full pay for the whole period of their unemployment.

"From the workers' side, the Wagner Act, in short, reduces the risks of striking to a minimum, at the same time that it greatly increases the potential gains from striking. On the other hand, it imposes upon the employer such heavy potential risks in not taking back striking workers on terms satisfactory to them that he will think many times before attempting to replace the strikers with other men. The pressure upon him to accede to the demands of the strikers becomes very great, not because of the economic, but because of the legal risks involved. It may be true that, technically speaking, these risks can come only through 'unfair labor practices' or 'discrimination' on his part; but as he does not and cannot know in advance what the strikers will contend, or what the Labor Board will decide, his actual risks are much greater than his theoretical ones. The Wagner Act does nothing to discourage strikes or threats of strikes to compare with what it does to make them profitable."

Nosing Artillery Shells with Large Carbide Dies

WHAT are believed to be the largest cemented-carbide dies ever made have been produced by the Vascoloy-Ramet Corporation, North Chicago, Ill., for the cold-nosing of 105-millimeter shells. The nosing of the shells is done in conventional vertical presses, the shell being held in a fixture on the press while the die descends and performs the nosing operation. Approximately 120 shells an hour per press are being nosed in this manner.

In the past, the cold-nosing of shells caused scoring and galling, resulting in a high rejection percentage and considerable die wear. This difficulty is overcome by the use of the carbide die. This die consists of a tantalum-tungsten-carbide insert, the inside of which is finished to the contour of the shell, and a heavy steel casing in which the insert is firmly mounted. Examination of the dies after several weeks of operation showed no measurable die wear. It is estimated that each die will nose several million shells.

Tantalum - tungsten - carbide Die Used for Nosing 105-millimeter Shells in a Vertical Press at the Rate of 120 Shells an Hour

* * *

June Gear Production Shows Increase

The American Gear Manufacturers Association reports that the sales of industrial gears for June were 132 per cent above June, 1940, and 9.5 per cent above May this year.

Electric Indicating Universal Drill Jig

By FRANK R. YANCHEK, Machine Shop Foreman
Worthington Pump and Machinery Corporation
Harrison, N. J.

IN these days of increasing demand for greater production for national defense, the weeding out of minor bottlenecks in the various machining operations performed on small parts can be an important factor in increasing plant efficiency. Thus, in our own plant, we were continually faced with the problem of efficiently handling the drilling and tapping of a variety of pieces in small lots of one to a dozen. Because of the variation in the size of each piece, and in the location and number of holes, it was necessary to either lay out each piece separately or else to construct a jig for each one.

The thought occurred to the writer that a solution might be found in the design of a universal jig that could handle a variety of parts for drilling and tapping rapidly, without much adjustment for change-over. The result of this idea is the electric indicating universal drill jig shown in Fig. 1. This jig consists essentially of the following parts: A faceplate, to which the work can be clamped or bolted; an automatic centering device for the initial location of the work on the faceplate before it is clamped in place; a bracket supporting a movable radius arm with a bushing to locate the position of the drill; a contact arrangement to close an electric circuit when the faceplate has been rotated to the correct drilling position; a series of three indexing pins, only one of which is used for any one setting of the work, to engage three spacing plates for exact location of the faceplate; and a separate indicating and control board with toggle switches and a signal lamp to permit the selection of the desired set of contacts for the required hole lay-out and, when selected, to indicate when the faceplate has been rotated to the successive proper positions.

The operation of this universal drill jig is simple and positive, with the possibility of errors due to the human variable largely eliminated. The main part of the unit can be readily placed on the table of any kind of drilling machine. The associated indicating and control box can be set on any convenient support for temporary use or it can be bracketed to the drilling machine column for permanent location.

The work is placed about in the center of the supporting faceplate *A*, Fig. 1, and the three centering arms *B* are then actuated by turning a small handwheel, which causes the pinion *C* to engage the quarter-circle rack *D*, fixed to the under side of the faceplate. Each of the centering arms has two pins. The outer pin *E* fits in a hole in the outer casing *F*. The inner pin *G* projects into a hole in the rotating member and also slides along a slot in the centering arm.

When the pinion is turned, it causes the faceplate to rotate with respect to the outer casing. Each of the centering arms is thus caused to rotate the same amount about its outer pin *E*, and when these arms are rotated inward, they automatically center the work and firmly grip it while it is being clamped to the faceplate. These arms must, of course, be brought to bear against a concentric surface of the work. If the lowest radial surface is rough and unfinished, and there is a finished concentric surface, such as a hub, higher up, the three radial arms can be lifted on their pins until they clear the lower part of the piece and engage the finished hub.

With the work located concentrically with respect to the axis of rotation of the faceplate, the supporting bracket *H* is now raised to the proper height, and the radius arm *I* adjusted to the proper distance from the center of rotation by the rack and pinion *J*, according to an indicating scale (not shown on the drawing). The drill bushing *K* is now in its proper location.

Each of the toggle switches shown in the control box *L* are numbered, and these numbers indicate different settings of the faceplate for equally spaced angular positions. There are switches for 2, 3, 4, 5, 6, 8, 9, 10, 12, 16, 18, 20, and 24 divisions or, in other words, holes evenly spaced around a circle.

For the purpose of illustration, let it be supposed that the switch *M* for a 16-hole setting is thrown. This closes the circuit from the power supply through to the spring-back contact ball *N* located in the laminated phenolic support *O*. A similar spring-back contact ball is electrically connected to each of the toggle switches, and each contact ball is located vertically in such a position that it makes contact with a row of bronze pins projecting from a brass cylinder *P*. This brass cylinder is fastened to the rotating member *Q*, which supports the faceplate by screws, as shown, but is entirely insulated from it. The bronze pins are set equidistantly around the brass cylinder in horizontal rows. Each row consists of a different number of pins, corresponding with the number of holes for which the jig is set.

Thus, as the faceplate is rotated, the contact ball *N* impinges successively upon a row of sixteen equally spaced pins. Each time the contact is made, the circuit to the power supply is completed through the brass cylinder *P*, the return contact pin *R*, which is in constant contact with the cyl-

inder, and the signal lamp *S*, which lights up. In this way, a visual indication is given for each of the sixteen equidistant positions of the revolving faceplate.

These sixteen pin positions coincide closely with the positions of sixteen 5-degree tapered slots in the index-plate *T*, into which the index-pin *U* can be inserted. Thus, with the faceplate almost correctly located by the signal light, the insertion of the index-pin exactly locates the work for drilling. There is no hunting for the proper slot in the index-plate, although there may be a very slight movement of the faceplate in either direction to fully seat the index-pin. After a hole is drilled, the index-pin is withdrawn from the slot, the work is indexed to the next position, as indicated by the

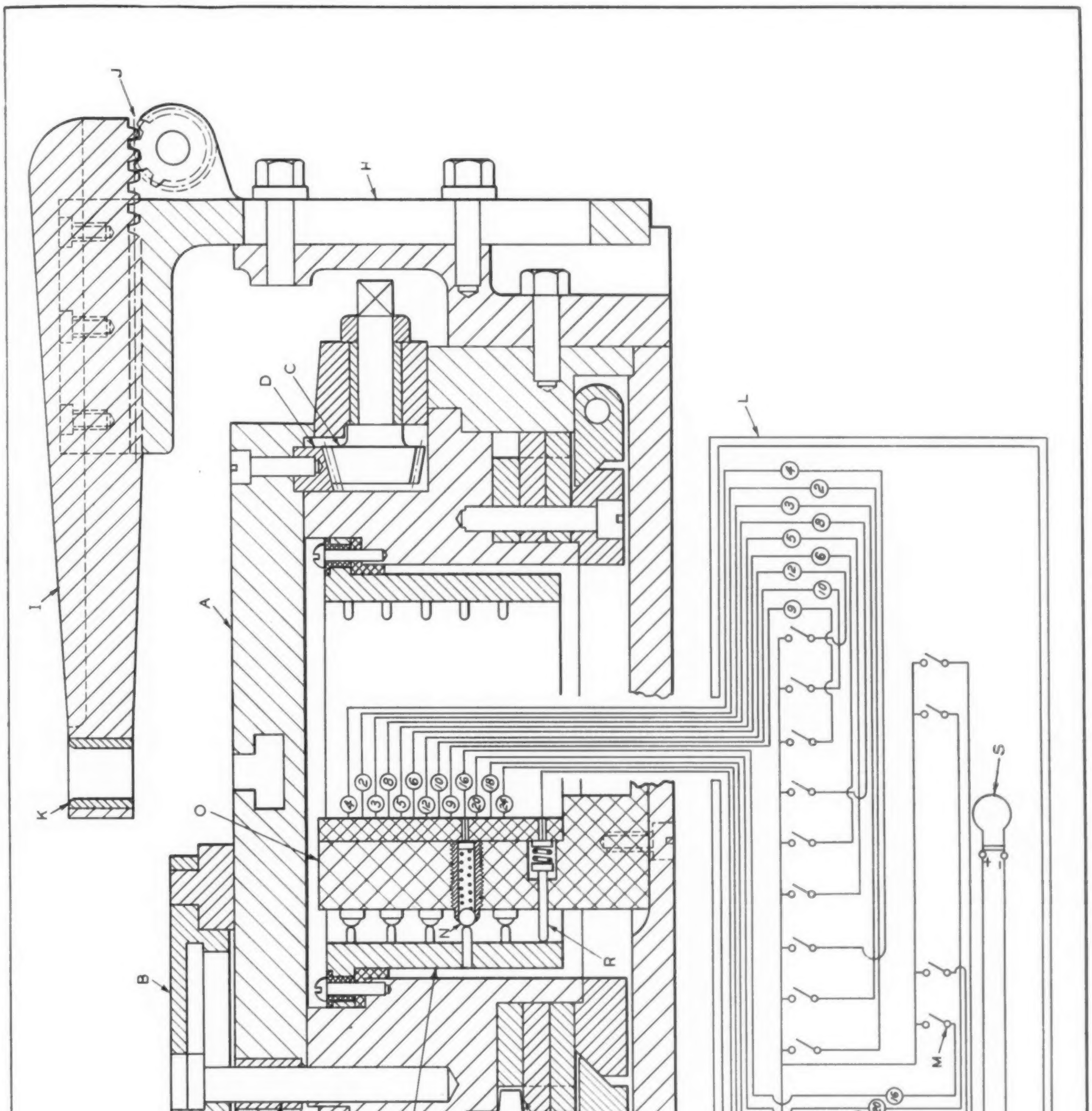
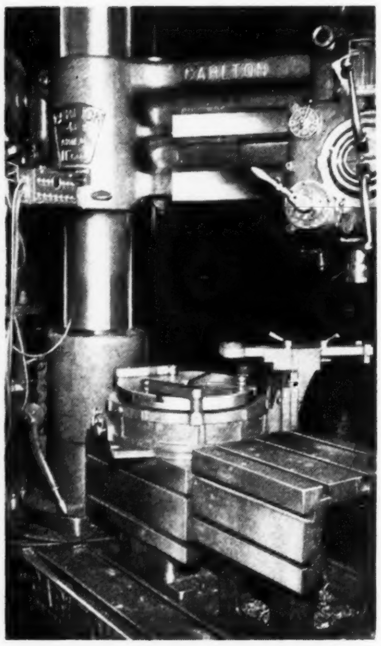


Fig. 1. Electric Universal Drill Jig that can be Set to Automatically Indicate the Proper Drilling Positions for Thirteen Angular Lay-outs

Fig. 2. An Electric Indicating Universal Drill Jig of 16-inch Diameter Capacity in Use on a 4-foot Carlton Radial Drill. The Electrical Control Box is Located at the Upper Left



signal lamp, and the index-pin inserted in the next slot that is presented to it for exact positioning.

When the jig is to be set up for a different job, it is only necessary to place the new work on the faceplate, automatically center it with the three locating arms, adjust the radius arm to the correct height and length, and then throw out the "16" switch and throw in a new switch to obtain the right number of holes. The drilling operation can then proceed immediately.

The fixture shown in Fig. 1 will handle work up to 9 inches in diameter, and is at present being used on a sensitive drilling machine. A larger jig is shown in Fig. 2, which will handle work up to 16 inches in diameter. This jig is now being used on a 4-foot Carlton radial drilling machine. As designed, these jigs have an accuracy of about plus or minus 0.0015 at the extreme radius, but they could readily be constructed for more exact work if required. These jigs are also designed so that they can be fastened to angle brackets for rotating and positioning work in a vertical plane. No special adjustments are necessary when operating in this manner.

As used in our plant, one of these universal jigs generally handles about thirty-five different jobs in the course of a day, with orders for each job running from one to twelve pieces. During the first month after the installation of one of these jigs, we saved about $380 in lay-out expenses alone. It is impossible, of course, to estimate what the expense would have been had jigs been built for each job. The cost of building the 9-inch universal drill jig was about $300.

* * *

Adapting Equipment for Making Motors to the Manufacture of Howitzers

At the General Electric Co.'s plant in Erie, Pa., 75-millimeter howitzers for the United States Army are being made on machines and equipment previously used for building electric motors for street cars and locomotives. These howitzers are towed on pneumatic tires by motorized equipment. Some have even been carried by airplane in maneuvers. This weapon hurls a fifteen-pound shell nearly 3 inches in diameter more than five miles.

The fact that the howitzer is only 47 inches long permitted the boring operations to be performed on turret lathes available in the plant, and with some changes, other machine tools on hand were adapted for this work. Special rifling equipment had, however, to be installed. On the assembly line, the men who formerly assembled electric motors are now assembling howitzers.

Portability, high striking power for the weight of the weapon, and complete interchangeability of parts are features of these howitzers. They can be quickly disassembled into sections small enough to be packed on mules. The heaviest part is the gun tube which, with its muzzle and breech hoops, weighs only 221 pounds. The howitzer is especially useful for dropping projectiles accurately behind obstructions, such as hills and buildings.

* * *

Paints and Finishes for Industrial Machinery

Machinery finishes must resist many conditions that cause ordinary paints and enamels to deteriorate. They must be impervious to oil, grease, and similar solvents. They must be able to withstand considerable temperature variations—from the intense cold in winter to the intense heat produced by operating conditions. They must also be able to resist abrasion to a considerable extent. In some industries, the constant washing of equipment with a hose gradually causes failure of the paint film.

It is pointed out by E. I. du Pont de Nemours & Co. that the new synthetic resin-base machinery finishes recently developed possess greater durability than the older oil- or varnish-type enamels. The new finishes are relatively unaffected by contact with petroleum oils or grease, and highly volatile thinners affect them but slightly. The dark colored machinery finishes of this type retain good appearance even when exposed to intense heat. The flexibility of the finish makes it resistant to blows and reduces the liability to cracking or chipping.

When applying these new finishes, grease, oil, rust, or deposits of any kind must be carefully removed. The surfaces should be washed with turpentine, after which the finish may be brushed or sprayed on. One or more coats may be used, depending on the quality of the finish desired.

The Place of the Public Library in Industrial Training

By DOROTHEA F. HYLE
Kansas City, Mo., Public Library

THE public library has a very definite place to fill in the American way of life. Until ten years ago its services were confined, in the main part, to those who came to the library. Today it reaches beyond the confines of its own walls and seeks to promote the services through which it meets the needs of the community.

Much has been said of the use to which reference rooms may be put by business and professional men who seek aid from the library, but less has been said of the use to which the library may be put in the industrial field, with the ever increasing need for industrial training. Now that trade schools are open in most large cities from late afternoon until early morning, public libraries are being more and more relied upon as adjuncts to the successful teaching of industrial work. With attention focussed on the needs of the industrial worker, the public libraries are making an effort to spread information concerning books and technical material to those entering the industrial field at this time.

Many large public libraries have technical librarians, and there are special librarians in manufacturing plants, banks, and research laboratories who work hand in hand with the libraries in their vicinities. These librarians are trained to assemble material, and in carrying out the routine of their work, are able to bring to the public all types of useful material. Much technical information is not yet in book form, but must be collected from various sources—technical trade journals, government documents, etc. Many of these sources are not easily available to the average student; hence, the public library meets a definite need of the community. With the great number of manufacturing plants being opened all over the country, with training schools busy day and night, with production at its peak, and with industrial centers humming with activity, the need for this type of service is uppermost in the mind of the wide-awake public librarian who strives to satisfy the demands of library users.

Librarians have not been "asleep at the switch." The American Library Association has issued a pamphlet on the need of books for industrial training. Instructors everywhere realize that students can learn industrial methods faster with the aid of books. After the completion of a training course, when the student is "on his own," the need for books becomes even greater.

As one example may be mentioned how the Kansas City, Mo., Public Library has carried on a highly successful campaign to give the citizens of Kansas City an appreciation of the uses to which a public library may be put in the matter of industrial training. A bench lathe, complete with work bench and cabinets, was lent to the library for display in the rotunda. A magazine rack was filled with pamphlets on subjects of value to those interested in different phases of industrial work. Posters were placed in prominent positions, and a five-page mimeographed list of books suitable for use in industrial training was compiled by one of the reference assistants of the library. The books, themselves, were arranged in proximity to the remainder of the exhibit. Examples of work done by students in the manual training and trade school departments of the public schools of the city were also exhibited in two large glass cases.

The pamphlet previously referred to, issued by the American Library Association, together with a copy of the mimeographed list of books and a letter announcing the opening of the exhibit, was mailed to one hundred and fifty industrial concerns and industrial schools in the vicinity. The services of any public library can be similarly advertised at very little expense. Such exhibits will help to indicate what books would aid training in the industrial field and will enable teachers and students to select the books most suited to their needs.

* * *

Lubricant Distributors Working on the Airbrush Principle

A line of automatic spray type lubricating devices suitable for use with lubricants containing colloidal graphite has been developed by the Paasche Airbrush Co., 1909 Diversey Parkway, Chicago, Ill. These devices are designed to spray the lubricant on working surfaces automatically and are provided with a universal type of mounting that makes it possible to easily and quickly adjust the lubricator to any desired position or angle. These devices permit the air-operated pistons controlling the spray action to be started and stopped almost instantaneously, so that accurate regulation of the amount of lubricant sprayed is assured. The design is such that intermittent operation providing as high as 150 "shots" per minute can be obtained if desired. These lubrication "airbrushes" operate on a minimum of 35 pounds per square inch air pressure and are provided with different kinds of heads for different applications.

Special Problems in Making Aircraft Gears

Abstract of a Paper Presented before the Twenty-Fifth Annual Meeting of the American Gear Manufacturers Association at Hot Springs, Va., by John L. Buehler, of the Indiana Gear Works, Indianapolis, Ind.

BECAUSE most aircraft engine parts are extremely light, distortion in heat-treatment presents a serious problem. As a consequence, considerable machining has to be done on material in the hard state. Standard production methods of machining to grinding stock, copper-plating for selective carburizing, cutting, carburizing, and hardening, and finish-grinding meet only too often with disaster. Each intricate part must be treated as a special case, and a complex and usually quite unorthodox method must be worked out for it.

The greatest single machining problem is that of maintaining close concentricity between a number of different surfaces, such as internal involute splines, external splines, bevel, spur, and helical gear teeth and bearings, all of which may appear on a single part, and all of which may be required to be concentric with each other within 0.001 inch. Obtaining basic finishes in hard alloys in thin webs, large radii, and deep chamber bores without chatter, tear, or tool marks, so that perfectly smooth polish can be obtained without undue dimensional change, is another serious problem. Of equal importance is the necessity for maintaining control surfaces that will not be affected by distortion in heat-treating, so that final machining operations on the hardened surfaces can be performed true with operations performed on the work in the annealed state. The problem of finish divides itself generally into three parts pertaining to gear teeth, bearings, and general surfaces. The following observations are based on the practice of the Indiana Gear Works, Indianapolis, Ind.

No method of finishing gear teeth is good enough; one must always compromise with the best practical method for the given application. In general, where gears can be ground, they are. But many internal gears, cluster gears, and straight-cut bevel gears cannot be ground by ordinary methods. One or two engine designs have permitted the occasional use of ground spiral bevel gears, but most bevel gear trains embody at least one shaft with projecting hub which requires the use of straight-cut bevels throughout the entire train. For example, the Allison production engine uses about twenty straight-cut bevel gears.

Many times spur or helical gears which cannot be ground are made of oil-hardening steel and treated to 50-52 Rockwell C. These can be shaved. Often they are finish-cut at that high hardness on the Fellows gear shaper, removing up to 0.020 inch on a side, with ordinary high-speed cutters operating at about 10 feet per minute, and excellent finishes are obtained, comparable in quality to ground teeth.

Gears that are to be carburized must be cut in a fairly soft state. Annealed or normalized steel, however, cannot often be cut satisfactorily, particularly if the material has a banded structure. The practice followed on such steel usually involves quenching in oil after an hour's soak around 1500 degrees F., and then tempering at from 800 to 1200 degrees F. for several hours, depending on the analysis of the material. The result is a finely spheroidized sorbite, homogeneous and crisp, that machines with clean hard chips which spring away and do not mar the tooth surfaces.

Finishing Surfaces of Gear Teeth

All gear-tooth surfaces, whether ground or machined, should be buffed lightly to remove any surface roughness that might be a point of stress concentration. For this purpose, soft stitched muslin buffs with 80-180 grit buffing compound are used. All corners and edges of teeth must be rounded. A thirty-second of an inch is general for average pitches. This is done not only to prevent fatigue, but also to remove carbon concentration at corners. In the carburizing process, carbon enters a corner from both sides, producing an excess of iron carbide and a consequent volumetric growth which would cause line contact and extreme loading at the corners.

These corners are broken by hand, where possible, with a very fine rubber cut-off wheel, 1/32 to 1/16 inch thick and about 3 inches in diameter. With a skillful wrist motion, an operator rolls a tooth space around both sides and the periphery of the gear, producing a slightly rounded chamfer all around the tooth space in one quick motion. The chamfer is then brushed with a tampico buff of 50-80 grit compound, the gear being held at an angle with the wheel, so that the tooth face is not buffed. A smooth, even radius is the result. In some places, these methods are not possible, and

pencil wheels or small dental wheels are used on air equipment and flexible-shaft machines.

Bearings are usually plain with bronze or silver bushings. Bearing diameters on shafts and hubs, as well as thrust faces on bevel gears, must be lapped and polished. These are finish-ground with a 300 to 500 grit wheel, polished in a speed lathe with 600 grit carborundum paper for a light hand "super-finish," and buffed lightly with rouge on muslin.

All non-functioning surfaces must be smooth-ground or hand-polished. When the surface is not readily accessible to a large wheel, hand-polishing is always most economical. Such operations are conducted on light speed lathes equipped with three-jaw universal chucks. The jaws are padded to prevent marring the work. For bore type parts, the operator chucks a length of maple rod and taper-turns it to fit the parts. Rough polishing is done with abrasive bands on small flexible rubber drums. These vary from 1/4 inch to 2 inches in diameter, and are used in air and flexible-shaft equipment for polishing webs and oil-holes. Final polishing is then done with 180 grit Aloxite cloth on a stick, the work rotating from 500 to 5000 R.P.M. Long oil-holes are finished in a Sunnen honing machine with special mandrels designed for the job. All surfaces are buffed and degreased immediately before final inspection.

Heat-Treating Methods

Almost all aircraft engine gears must be hardened without pitting, scale, decarburization, or serious distortion. Only the most accurate of heat-treating equipment is suitable, and the heating rate must be carefully controlled. In general practice, most of the distortion that is blamed on the steel, improper quench, machining strains, and many other causes, occurs principally in heating. As steel is heated, it expands. This expansion proceeds at a rather uniform rate until the first critical point Ac_1 is reached. As the steel is further heated, it contracts until the third critical point Ac_3 is reached. After that, further heating produces expansion. Therefore, if a piece with appreciable variation in section thickness is heated too rapidly, there will be heavy sections that are cold—below the critical range and expanding; medium sections that are warmer—in the critical range and contracting; and thin sections already fully in solution, which will be expanding. If the simultaneous expansion and contraction are severe enough to load the material beyond its hot yield point, a permanent set will occur and the material will become warped.

On cooling, when the material is at a uniform temperature throughout, the parts that have been stretched by distortion will be under compression, and the parts that have been hot-compressed will be too short, and will be under tension. Thus, the piece will be internally preloaded. This preload must be subtracted from the normal ultimate strength of the material to obtain the working strength of the part. If the internal load is greater than the ultimate strength of the part, then it will fly apart in the quench or shortly after. This is not the fault of the quench in any typical case, as the material does not go through a critical period in quick cooling, and hence does not have some sections contracting and some expanding. If a difference of not more than 5 or 10 degrees F. is maintained between thick and thin sections during heating, however, little distortion will occur in very light parts, and no quenching press or fixture need be used.

Quenching on a Falling Heat

Distortion does occur, however, in some parts during quenching. This distortion, in high alloys, can be greatly mitigated by quenching on a falling heat. As the material starts to cool in the furnace, it may drop several degrees before any structural change begins to occur. With high alloys, the lag is considerable. Thus, it is possible to heat steel until the desired structure is obtained, then let it cool in the furnace to the lowest point at which the structure will be retained, before quenching. For example, maximum refinement, hardness, and physical properties, and minimum distortion can be produced in a number of representative steels by treating as follows:

S A E 4140—Heat to 1425°; cool to 1325°; quench
S A E 3312—Heat to 1450°; cool to 1175°; quench
S A E 2512—Heat to 1420°; cool to 975°; quench
S A E 4340—Heat to 1425°; cool to 725°; quench

The latter steels are, of course, not even red when quenched; yet the results are entirely successful.

The foregoing data does not apply to furnace temperature, which is too often deceptive, but to actual work temperature. No accurate work can be done unless a thermo-couple actually touches the load. Leeds & Northrup Vapocarb equipment is used for hardening, and the temperatures of both the work and the furnace wall are recorded and their difference controlled. For hardening, a very slightly carburizing and lightly reducing atmosphere is used. Only gas carburizing has been found satisfactory, particularly on medium and high alloy steels with an austenitic tendency.

Development of Case Carbon Content Control

About six years ago the Indiana Gear Works recognized a need for developing its own standards for case carbon content. It was just beginning to be realized that only a very narrow range was satisfactory—that a little too much carbon in alloys with 3 1/2 to 5 per cent nickel produced retained austenite, so that the case would not harden uniformly, and that a little less carbon would not be enough to allow peak hardness. The International

Nickel Co. generously lent this company the very comprehensive data which it was accumulating on hardenability and various other properties of 5 per cent nickel steel of from 0.08 carbon to 1.40 carbon. With this material as a background, it was found that the outer case carbon content would have to be kept between 0.70 and about 0.90 per cent carbon.

Production carburizing of this type can only be done under laboratory conditions. As the load is heated to the carburizing temperature, the atmosphere must be kept neutral. At the moment the carburizing temperature is reached, an atmosphere empirically predetermined for the given steel, load density, and desired case depth and carbon content is applied. If the load is to carburize for, say, two and a half hours, then at two hours one of several test coupons is removed from the furnace through a suitable small opening.

This is immediately examined in the laboratory for case depth and approximate case carbon content. If the load has carburized too rapidly, it is stopped immediately. If it has carburized too slowly, more time can be allowed. If the carbon content is too low, the atmosphere can be enriched. If it is too high, the atmosphere can be made almost neutral, as the carbon diffuses. It is the author's belief that no delicate parts may, under any circumstances, be quenched from the carburizing temperature. A cooling pit should always be used—one that will allow the load to cool sufficiently slowly to be machinable in subsequent operations, but that will not be so well insulated as to cool the load so slowly that the case will diffuse.

A double quench is never felt to be desirable. The core on highly stressed parts must always be in complete solution. No free core ferrite is ever permitted by the U. S. Army Air Corps. For maximum over-all refinement, the quench on the falling heat at a few degrees above the third critical point Ar_3 of the core, as previously mentioned, is the best method yet found.

Quenching oil should always be kept above 100 degrees F. The top limit is usually the flash point of the oil. Very hot oil may cause the loss of a point or two of hardness in low alloys, but is conducive to great uniformity. Forced circulation of quenching oil is almost never in the right direction. Natural thermal circulation is greatest at the hottest points of a load, where circulation is most needed. The practice of this company is to submerge the load quickly, then very slowly lower it to within not less than 6 inches of the bottom without any agitation whatsoever.

Importance of Proper Tempering

Tempering is a very important though often an improperly executed operation, and one upon which the integrity of the manufacturer must be relied. The major purpose of tempering is to relieve strain, yet too often it is only used to meet blueprint hardness specifications. Strain relief is a function of time and temperature. Hardness is primarily a function of draw temperature, and can usually be achieved in a few minutes. Yet strain relief is not complete in thin sections after five hours at 300 degrees F. or after three hours at 500 degrees F. Too often it is considered a prodigal waste of time to leave urgently needed parts in a busy furnace for six or eight hours. Yet one unrelieved strain in one small part can easily cause an engine failure.

Production of any intricate part is impossible without a complete analysis of every operation to be performed. The method is correct only when a union of productivity and inter-operation control is achieved. All methods adopted by this company on more complicated pieces are a result of analytical conferences between two to five men, fully conversant with every operation to be performed.

* * *

Hints on Cleaning Castings

When fragile castings are tumbled in an airless blast cleaning mill such as built by the American Foundry Equipment Co., Mishawaka, Ind., short pieces of split and cut up old rubber tires or small wooden blocks mixed with the load will save the castings from injury and will reduce the abrasive wear on the machine.

Mixed loads of large and small castings are sometimes advantageous, since there is less likelihood of breakage. The cleaning of the parts is faster, as all sides of the pieces are more likely to be exposed to the abrasive blast. A short hook or rake is handy for pulling the last few castings from the mill when the cleaned work is being unloaded. A compressed-air hose with a button nozzle, long enough to reach all parts of the inside of the machine, is useful for periodic cleaning. It can also be used to free the blast cleaning unit of all abrasive and dust when changing the blades. The abrasive supply of the machine should be replenished between loads. An adequate supply of the correct size of abrasive assures thorough and fast cleaning of the work.

* * *

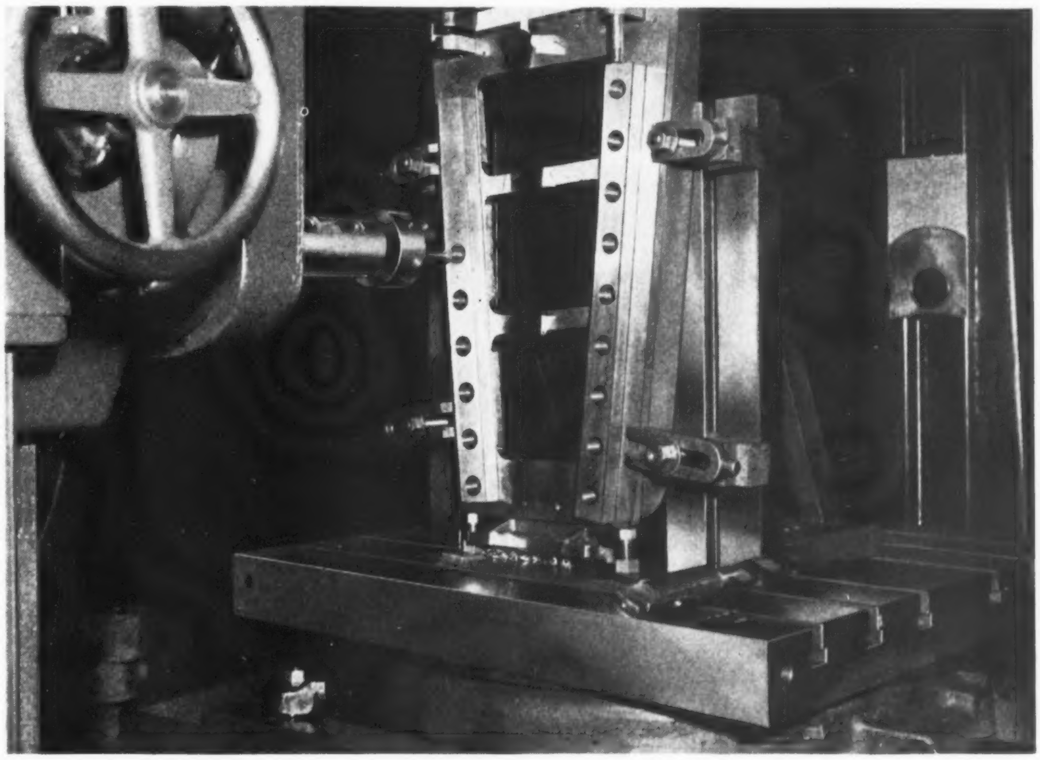
Sub-Contracting Assumes Great Proportions

As an example of the amount of sub-contracting now being done, it is of interest to note that the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has "farmed out" $10,000,000 worth of emergency contracts to more than 100 companies. These sub-contracts include pressed-steel housings and other stampings; cams; bearings; worm-gears; spun aluminum shapes; dies and tools; boring-mill work; reduction gears, etc. Throughout the industry, many smaller concerns, unable, themselves, to bid on complete contracts, are in this way able to share in the defense work.

Accurate Jig-Making Operation in Tool-Room of an Aircraft Factory

A CONSIDERABLE proportion of the work performed in the machine shop of an aircraft factory consists of producing parts for the great number of jigs that are required in the quantity fabrication of planes. The accompanying illustration shows a Lucas horizontal boring, drilling, and milling machine being used in the factory of the Lockheed Aircraft Corporation, Burbank, Calif., for drilling and boring eighteen holes in a boom jig member. The holes were produced at an angle of 7 degrees 1 minute relative to the side surfaces of the jig part, and the holes on opposite sides of the jig were machined to opposing angles. The circular table of the machine facilitated making the necessary angular settings. In starting each hole, the operator lined up the machine spindle with a previously laid-out prick mark on the jig member. Then he used a small center drill to start the hole, next a 7/32-inch drill for producing a hole of that size completely through the work, and then a 1 1/64-inch diameter drill for the full length of the hole.

Upon the completion of these operations, the drill chuck was removed and a Craley offset boring head mounted on the spindle as shown for finish-boring the hole. The holes on one side of the jig were bored "right on the line" to 1.250 inches, and on the other side to 1.180 inches.



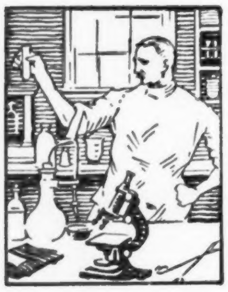
Precise Tool-room Work is Necessary in Manufacturing Members for the Great Number of Jigs Required in Airplane Fabrication

"Torflex Graphited-Bronze on Steel" Bearings

A NEW line of "Torflex" bearings with inner walls of a new, thin material of either plain or graphited bronze mounted on steel, is now being made by Harris Products Co., 5408 Commonwealth Ave., Detroit, Mich. These bearings are available in a considerably wider range of sizes and shapes than the older cast styles. They possess increased resistance to pounding or shocks and a comparatively low coefficient of friction. The new bearing material is first made in sheet form, and is then cut from the sheets and shaped; in the split form, they are quickly assembled with a rubber insulating wall and an outer wall, which latter may be made from seamless steel tubing, brass, stainless steel, or practically any material desired.

The increased shock resistance of the new bearing material is expected to make it suitable for applications where the bearings are subjected to severe impact and shock, and where cast bronze bearings alone would not stand up well. In the "graphited-bronze on steel" type, the bearings are used without lubrication for surface speeds up to 30 R.P.M. Beyond that rate, lubricant must be supplied.

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

High-Temperature Lubricant that Leaves No Residue

A new high-temperature lubricant has been developed by the Standard Oil Co. of New Jersey, 26 Broadway, New York City. The new oil, known as "Caloria," gradually vaporizes when used, and in time, completely disappears without leaving any residue. Thus, by simply renewing the supply of oil periodically, high-temperature equipment can be operated indefinitely without shut-downs due to lubrication troubles. Heretofore, difficulty has been experienced with lubricating oils and greases when used at high temperatures, because of the deposits of carbon and "varnish" which remained after evaporation of the lubricant.

For bearings in which the oil supply cannot be renewed frequently enough to prevent complete disappearance of the lubricant, the new lubricating oil is available with small amounts of colloidal graphite added to it; in this form, it is known as "Van Caloria." The new product is available in a range of viscosities to meet varying methods of lubrication. 201

Non-Porous Plastic Coating for Metals

A plastic coating for metals has been placed on the market by the Marley Chemical Co., 983 E. Milwaukee St., Detroit, Mich., under the trade name "Marlox." This coating material, which may be used as a priming coat for other finishes or alone to provide protection against rust and corrosion, has the advantage of almost complete absence of porosity. It has a high degree of adhesion, and is not affected to any noticeable degree by temperature changes. These qualities make it particularly valuable as a coating for welds to prevent corrosion and rust-creepage in the seams and folds.

Marlox can be applied by spraying, brushing, or dipping, and when used to prevent rust or corrosion a coating of about 0.00005 inch is generally sufficient. For a priming coat, a thickness of 0.0005 inch is applied. Dilution with "Solveso" is recommended, a gallon of finishing mixture covering from 1000 to 2000 square feet of metal surface. The coating dries quickly, and can be handled in five to ten minutes after application. One hour's drying time is recommended where possible before applying enamels or paints.

Tests by automotive manufacturers have shown that metal coated with this plastic was completely protected against the effects of moisture when kept in a humidity chamber for six months, with an average relative humidity of 98.5 per cent at a temperature of 94 degrees F. A similarly coated panel was subjected to a salt spray test for 600 hours, and stood up with entire satisfaction. . .202

Five Grades of Ampco Metal Used in Aircraft Windshield Wipers

Five grades of Ampco Metal manufactured by Ampco Metal, Inc., Milwaukee, Wis., are used in the construction of Acrotorque windshield wipers for Army, Navy, and commercial aircraft. These hydraulic wipers weigh 6 1/2 pounds and develop up to 1/2 H.P., using 800 pounds pressure.

Owing to their location in close proximity to the aircraft compass, the metal used in their construction has to be non-magnetic, and in addition, has to meet the various requirements imposed by such parts as bearings, gears, shafts, cams, valves, and valve seats. The alloy chosen was adopted after a continuous test run of 85 hours, during which the motor and associated parts ran through 2,000,000 reciprocating cycles. The variety of grades available made it possible to select compositions best suited for each part. 203

Injection-Molding of Mycalex Widens its Field of Application

Objects made from Mycalex, a material consisting of ground mica and a special type of glass, can now be molded by the injection-molding process; this is a new step in plastics manufacture developed by the plastics department of the General Electric Co., at Pittsfield, Mass. The material is expected to find widespread use in the radio and

To obtain additional information about materials described on this page, see lower part of page 154.

electronic fields, chiefly because of its low dielectric power losses. It is also expected to become of value in the industrial control and heating industries because of its high mechanical strength, heat resistance, and dielectric value.

This material has been compression-molded for some years in plate and bar form and machined to the required forms. It has also been molded by direct compression methods into various insulation parts, such as rectifier seals and brush-holder studs. Now, by the injection process, the material can be produced in more intricate shapes, and will find many new applications.

In general, Mycalex has better electrical characteristics than porcelain, and comparable mechanical strength. In addition to its high dielectric and mechanical strength, Mycalex has a low power factor, high arc resistance, chemical and dimensional stability, and low coefficient of thermal expansion. It is impervious to water, oil, and gas, and is unaffected by sudden temperature changes. Metallic inserts can be readily molded into parts made from it. 204

Concentrated Liquid Tin Flux for Hot-Tinning

A concentrated liquid tin flux of the zinc chloride type for use in hot-tinning, in the manufacture of terne-plate (lead-tin alloy), and for soldering has recently been placed on the market by the Hanson-Van Winkle-Munning Co., Matawan, N. J., under the name "Fas-Tin-Flux." This new flux contains special addition agents to assure fast action, and is so made that it will be free from uncombined hydrochloric acid.

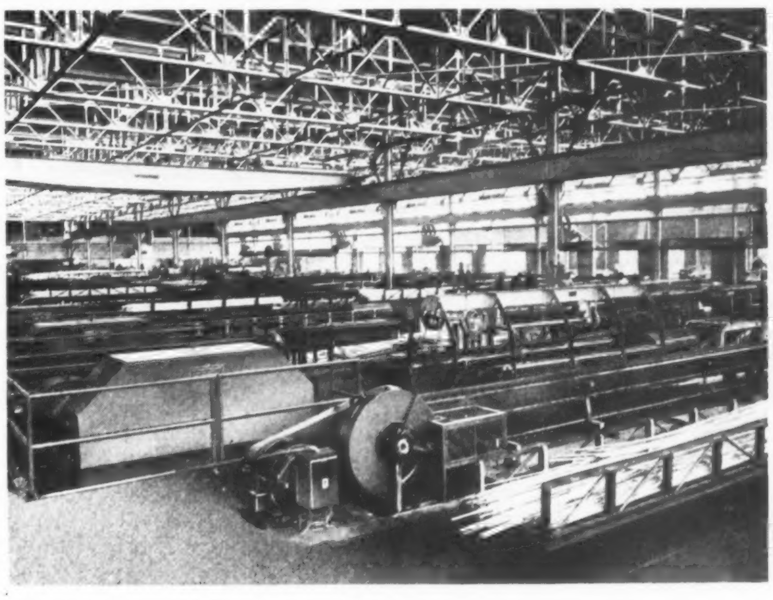
"Fas-Tin-Flux" can be poured on molten tin without danger of explosion. It will form a foamy flux blanket which will tend to harden unless constantly supplied with water by a drip. This is intentional, because zinc chloride is most effective as a flux when water is supplied with it. If necessary, as much as one hundred pounds of water can be used with each pound of "Fas-Tin-Flux" placed on the molten metal. The increased use of water leads to brighter coats. 205

Extruded Tenite for Replacing Aluminum Moldings

Since the use of aluminum for the making of war materials will doubtless require the entire output of the aluminum industry, there are many uses for peacetime purposes in which aluminum will be replaced by other materials, especially by plastics. For example, cover molding for the joints and the corners of walls which has formerly been made principally of aluminum, will now probably be made from extruded plastics. A plastic material that absorbs little moisture and is generally quite stable, known as Tenite II, was recommended by Gilbert Rohde in a recent talk on "Architectural Uses of Plastics" before the Princeton University School of Architecture, Princeton, N. J. "This use of plastics," said Mr. Rohde, "should by no means be regarded as a substitute. It is probably a normal step in engineering progress." 206

Belectromal—a Malleable Iron of Increased Strength

Belectromal is the name given to a new malleable iron, the fifth in a series of ferrous casting materials produced by the Belle City Malleable Iron Co. and the Racine Steel Castings Co., Racine, Wis. This malleable iron has high strength without sacrificing the ductility and machinability usually associated with this type of iron. It is intended for parts requiring greater strength than ordinary malleable iron, but having comparable ability to withstand shock and to machine readily. 207



The War has Enormously Increased the Demand for Light Metals, and More Aluminum is being Produced at Present than ever Before. The Aluminum Co. of America is Engaged in a $200,000,000 Expansion Program. One of the Company's Tube Works has Expanded Fivefold since the War Began, and Tubing is being Produced on a Twenty-Shifts-a-Week Basis. Production Capacity by the End of the Year will be Nine Times Greater than in September, 1939

To obtain additional information about materials described on this page, see lower part of page 154.

NEW TRADE  LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Fill in on Form at Bottom of Page 153 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the August Number of MACHINERY

High-Alloy Steels

ALLEGHENY LUDLUM STEEL CORPORATION, Oliver Bldg., Pittsburgh, Pa., has published two manuals on high-alloy steels, of special interest to students and instructors in trade and engineering schools and industrial defense courses, one of which treats of tool steel, and the other of stainless steel. The data given covers analyses, treatment, and basic uses. 1

Ball Bearings

NEW DEPARTURE DIVISION GENERAL MOTORS SALES CORPORATION, Bristol, Conn. Fifteenth edition of a handbook listing the principal types and sizes of forged-steel ball bearings made by this company. The book gives dimensions, capacities, tolerances, and mounting fits, as well as data that simplifies the selection of bearings. 2

Machine Tools, Small Tools, and Gages

PRATT & WHITNEY DIVISION NILES-BEMENT-POND CO., West Hartford, Conn. Booklet entitled "Impressions of Pratt & Whitney," containing a reprint of a series of advertisements showing the part machinery has played in providing the comforts and luxuries of modern life at a reasonable cost. 3

Carburizing Equipment

LEEDS & NORTHRUP CO., 4934 Stenton Ave., Philadelphia, Pa. Catalogue T-623, descriptive of the Homocarb method of carburizing by means of which a case of specified thickness can be obtained on a variety of work. Typical examples of the application of this method are shown, and data is included on the results obtained. 4

Aluminum Products

ALUMINUM CO. OF AMERICA, Pittsburgh, Pa. Booklet entitled "Aluminum in Aircraft," containing information on alloys and products; airframe fabrication; choice of materials and processes; and maintenance. Booklet entitled "Forming Aluminum," containing detailed information on drawing, spinning, and other forming operations. 5

Universal Testing Machines

BALDWIN SOUTHWARK DIVISION OF THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa. Bulletin 161, containing forty pages illustrating and describing the Southwark-Tate-Emery universal testing machine and other types of Southwark physical testing machines in capacities from 20,000 to 4,000,000 pounds. 6

Welding and Cutting Equipment

AIR REDUCTION, 60 E. 42nd St., New York City, is distributing a new publication known as "Airco in the News" which will be published bi-monthly, with the object of extending the understanding of the scope of the oxy-acetylene flame and the electric arc as production, repair, and maintenance tools. 7

Precision Lathes

SOUTH BEND LATHE WORKS, 725 E. Madison St., South Bend, Ind. Catalogue 50-B, illustrating and describing South Bend 9-inch precision lathes for production operations on precision work, and for tool-room work. All attachments, tools, and accessories for use with these lathes are also shown. 8

Non-Metallic Materials

CONTINENTAL - DIAMOND FIBRE CO., Newark, Del. Folder entitled "What Material?" containing information of value to the engineer in selecting the proper type of non-metallic material for a specific problem. This information is also available in wall-chart form for handy reference. 9

Turret Lathes

WARNER & SWASEY CO., Cleveland, Ohio. Catalogue entitled "How to Get More Production from Both Old and New Turret Lathes with Tools that Complete the Set-up," illustrating and describing tools and tooling equipment designed to increase production. 10

Metal Cleaning and Surface Preparation

OAKITE PRODUCTS, INC., 26 Thames St., New York City. Information covering proper cleaning and surface preparation in the electrolytic resistance spot-welding of aluminum and its alloys with special reference to aircraft production. 11

Precision Collets

HARDINGE BROTHERS, INC., Elmira, N. Y. Bulletin 41, listing the sizes of Hardinge precision draw-in collets to be used on different makes of lathes and milling machines. Capacities, major dimensions, and prices of the various standard-sized collets are included. 12

Electric Gages

PRATT & WHITNEY DIVISION NILES - BEMENT - POND CO., West Hartford, Conn. Circular 461, describing Pratt & Whitney multiple electric contact gages, developed to permit fast and accurate inspection, and a typical application in the inspection of shells. 13

Metal-Spraying Equipment

METALLIZING CO. OF AMERICA, INC., 562 W. Washington Blvd., Chicago, Ill. Publication entitled "The History, Purpose, and Practice of Metallizing," describing applications of this process in many different fields and equipment required. 14

Brush Nail Expansion Bolts

BRUSH NAIL EXPANSION BOLT CO., Greenwich, Conn. Folder containing data on Brush nail expansion bolts, by means of which all

kinds of fixtures can be rapidly attached to masonry without the use of a wrench or screwdriver. 15

Welding in National Defense

JAMES F. LINCOLN ARC WELDING FOUNDATION, P.O. Box 5728, Cleveland, Ohio. Pamphlet entitled "Welding in National Defense," giving important detailed information on the savings in time and cost obtainable through welding. 16

Milling Machines

KEMPSMITH MACHINE CO., Milwaukee, Wis. Three catalogues dealing, respectively, with Kempsmith Type G all-geared milling machines; Maximiller vertical milling machines; and Maximiller plain and universal milling machines. 17

Air-Conditioning Equipment

WORTHINGTON PUMP AND MACHINERY CORPORATION, Carbondale Division, Harrison, N. J. Circular C-1100-S23A, descriptive of air-conditioning units for application in shops, stores, offices, etc. 18

Boring Mills

YODER SALES CO., Cleveland, Ohio. Circular illustrating and describing the Yoder improved horizontal boring mill for tool and die plants, and production plants. 19

Belting

B. F. GOODRICH CO., Akron, Ohio. Catalogue Section 2181, containing tables on standard fractional-horsepower V-belts. Catalogue Section 2140, on Multicord belting for severe drives and heavy loads. 20

Hydraulic Grinding Machines

LANDIS TOOL CO., Waynesboro, Pa. Catalogue J-241, describing the features of Landis Type C hydraulic universal grinding machines and their applications on a variety of work. 21

Combination Sharpening Machine

BARBER-COLMAN CO., 203 Loomis St., Rockford, Ill. Circular 18, illustrating and describing the Barber-Colman sharpening machine for hobs, cutters, and reamers. 22

Semi-Automatic Lathes

MOREY MACHINERY CO., INC., 410 Broome St., New York City. Circular 715, illustrating and describing the Morey 27-inch semi-automatic lathe designed for production turning of steel shells. 23

Hacksaw Blades and Band Saws

CLEMSON BROTHERS, INC., Middletown, N. Y. Booklet entitled "Metal Cutting," containing much useful information on the proper selection and use of hacksaw blades and flexible-back band saws. 24

Pneumatic Tools

ARO EQUIPMENT CORPORATION, Bryan, Ohio. Catalogue 41, covering the complete line of Aro pneumatic tools for industrial use, including grinders, files, drills, screwdrivers, nut-setters, etc. 25

Welding in Machine Design

LINCOLN ELECTRIC CO., Cleveland, Ohio. Application Sheet 75, in a series on Machine Design, illustrating and describing the redesigning of a press outboard bearing bracket for welded construction. 26

Hacksaw Blades and Band Saws

VICTOR SAW WORKS, INC., Middletown, N. Y. Booklet entitled "Metal Cutting," containing suggestions on the proper selection and use of hand and power hacksaw blades and flexible-back band saws. 27

Riveting Machines

TOMKINS-JOHNSON CO., 617 N. Mechanic St., Jackson, Mich. Bulletin RK-1, containing complete specifications covering the automatic-feed Rivet-Pierce Rivitor made by this company. 28

Electric Brazing

THOMSON-GIBB ELECTRIC WELDING CO., Lynn, Mass. Bulletin describing "Tempobrazing," a new method of hard-soldering cold-worked copper and copper alloys on a production scale. 29

Business Management

WOLF & CO., INC., management engineers, 7 S. Dearborn St., Chicago,

---

To Obtain Copies of New Trade Literature

listed on pages 152-154 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Name .... *Position or Title* ....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm ....

Business Address ....

City .... *State* ....

[SEE OTHER SIDE]

Ill. Chart entitled "Business Management," analyzing three typical examples of management—modern, progressive, and static—and containing many valuable suggestions for executives. 30

Molybdenum Alloys

MOLYBDENUM CORPORATION OF AMERICA, 3201 Grant Bldg., Pittsburgh, Pa. Three catalogues containing data on molybdenum wrought steels, cast steels, and cast irons, discussing the methods of use and the metallurgical effects of molybdenum in steel and iron. 31

Centrifugal Pumps

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. Bulletin W-304-B2, descriptive of Worthington two-stage volute centrifugal pumps for applications where high efficiency and low maintenance are required. 32

Hydraulic Lift Trucks

LYON IRON WORKS, 805 Madison St., Greene, N. Y. Bulletin 123, illustrating and describing Lyon hydraulic lift trucks for the rapid and economical handling of materials. 33

Bronze Welding Alloys

BRIDGEPORT BRASS CO., Bridgeport, Conn. Booklet describing the bronze-welding of cast iron and steel, and listing bronze-welding alloys. 34

Welding Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Leaflet 18-333, containing useful information on the technique of seam- and spot-welding. 35

Temperature Control Systems

BROWN INSTRUMENT CO., Wayne and Roberts Aves., Philadelphia, Pa. Bulletin 27-7, descriptive of the Brown hot blast temperature control system for furnaces. 36

Self-Locking Nuts

ELASTIC STOP NUT CORPORATION, 2310 Vauxhall Road, Union, N. J. Circular describing the principle of operation of elastic-stop self-locking nuts. 37

Automatic Punching and Riveting Machines

ENGINEERING & RESEARCH CORPORATION, Riverdale, Md. Circular descriptive of the Erco automatic punching and riveting machines. 38

Electric Equipment

JOHN S. BARNES CORPORATION, 301 S. Water St., Rockford, Ill. Circular descriptive of an improved solenoid designed primarily for machine tool use. 39

Electrical Etchers

MARTINDALE ELECTRIC CO., Box 617, Edgewater Branch, Cleveland, Ohio. Bulletin illustrating Martindale electric etchers for use on metals, rubber, glass, Bakelite, etc. 40

Tools

BONNEY FORGE & TOOL WORKS, Allentown, Pa. Catalogue 41 (104 pages), covering the complete line of Bonney alloy-steel wrenches and tools. 41

Direct-Current Motors

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Descriptive Data 4004, on direct-current motors for service in mines, mills, and general industry. 42

Insulating Materials

GENERAL ELECTRIC CO., Bridgeport, Conn. Catalogue 55-102, containing 60 pages of data on the G-E line of insulating materials. 43

Lubricating Oil Filter

S. G. FRANTZ CO., INC., 161 Grand St., New York City. Bulletin 16-A, on permanent-magnet FerroFilter for lubricating oil purification. 44

Copper-Plating Process

UNITED CHROMIUM, INC., 51 E. 42nd St., New York City. Folder descriptive of the new Unichrome alkaline copper-plating process. 45

Balancing Machines

TAYLOR MFG. CO., 2330 W. Clybourn St., Milwaukee, Wis. Bulletin 761, on static universal balancing machines. 46

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 155-163 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description on pages 155-163—or write directly to the manufacturer, mentioning machine as described in August, 1941, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 150-151, fill in below the identifying number found at end of each description on pages 150-151—or write directly to the manufacturer, mentioning name of material as described in August, 1941, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

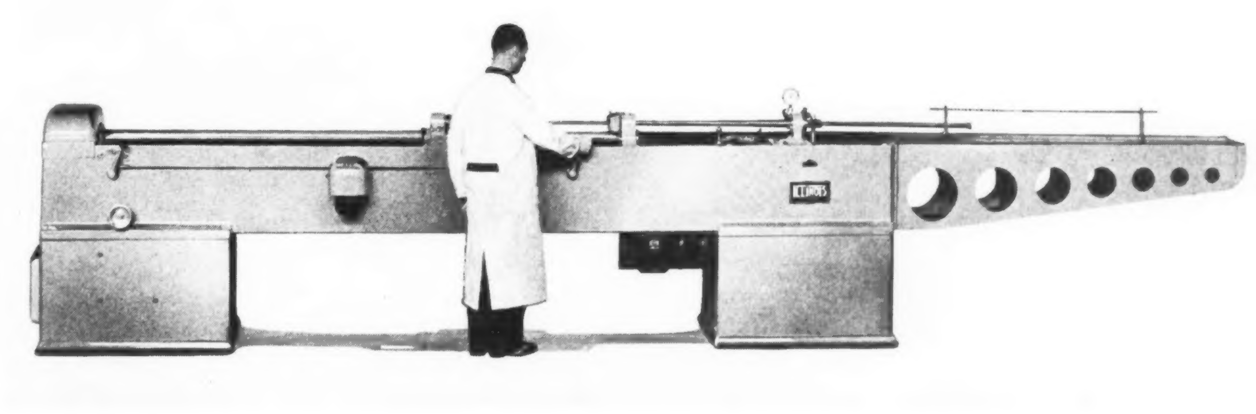


Fig. 1. Screw Type Broaching Machine Made by the Illinois Tool Works for Rifling Gun Barrels

Illinois Broaching Equipment for Rifling Gun Barrels

Speed and accuracy in broaching the helical rifling grooves in machine gun and rifle barrels have been made possible through the development of a new broaching system by the Illinois Tool Works, 2501 N. Keeler Ave., Chicago, Ill. All the methods and equipment for this new broaching system, including broaches, broaching machines, broach-sharpening machines, and broach-inspection fixtures, were developed under the supervision of the engineers of this company.

The screw type broaching machine shown in Fig. 1 was designed and built expressly for rifling the gun barrels, the screw being driven through V-belts by a reversible motor. The free-floating, ball-bearing, jaw type broach-puller contains a safety link which protects the broach against breakage. The by-pass valve of the high-pressure coolant unit is

Fig. 2. Machine for Sharpening Broaches Used in Rifling Gun Barrels

Fig. 3. Fixture Used in the Inspection of Rifling Broaches

To obtain additional information on equipment described on this page, see lower part of page 154.

set between 150 and 300 pounds per square inch, depending on the size and length of the barrel. All oil flows through a Purolator unit, which keeps it clean and free from the smallest particles which might scratch the broach or barrel.

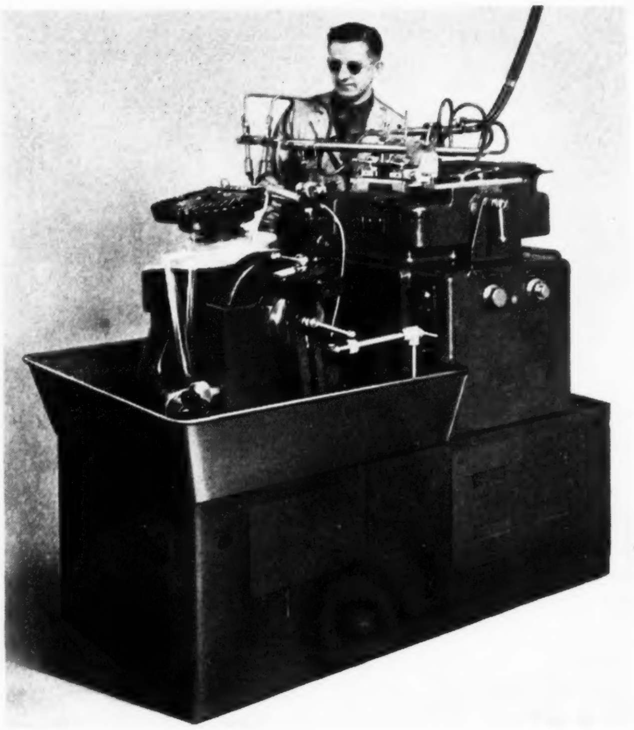
The principle of the rifling-broach sharpening machine shown in Fig. 2 is similar to that of other broach-sharpening machines. However, in adaptation to their specific duty, these machines are equipped with special steadyrests, interchangeable grinding and polishing spindles, and a diamond wheel-dressing device. Radius dressing, grinding-wheel diameter, spindle speeds, and angular spindle adjustment are all factors that have been given careful consideration, in order to assure the best job of sharpening.

The rifling-broach inspection fixture shown in Fig. 3 provides for visual inspection through a microscope of 20 × magnification. The sizes and steps of the broach teeth are checked by a snap-gage indicator. Visual inspection of the broaches determines if they have remained free from "pick-up." Inspection follows every sharpening to ascertain that every trace of dullness has been removed. The sharpened broach is checked on the diameters as well as on the face of the teeth. For inspecting the face of the teeth, the broach is swiveled to a high-angle position.

When the broaches are pulled through the rifle barrel, they produce their own spiraling motion or lead, no other device for turning besides a free-rotating puller being required. This ability of the broaches to follow their own lead is created by the sides of the teeth and by the helical chip-breakers in each tooth. The cutting lubricant is supplied under high pressure by a chamber which is slipped over the broach after it has been inserted in the barrel. The pressure chamber, locked in position, forces the lubricant over the broach and through the barrel. The construction of the broach facilitates the passage of large amounts of oil. Besides acting as a lubricant and coolant, the oil removes the chips from the cutting edges. 51

Gleason Automatic Surface-Hardening Machine

The Gleason Works, 1000 University Ave., Rochester, N. Y., has just introduced on the market an automatic surface-hardening machine which is designed to extend the advantages of oxy-acetylene flame-hardening to medium and small size bevel, spur, and internal gears, sprockets, and similar work. With this machine, both sides of a tooth are hardened simultaneously without distortion. Each tooth is hardened in exactly the same length of time and at the same depth as every other tooth. The machine has a capacity for handling bevel gears up to 33 inches pitch diameter, and is fully automatic in operation, including indexing from tooth to tooth. Change-gears are provided for indexing any number of teeth from 5 to 100, and most numbers up to 200.



Gleason Automatic Surface-hardening Machine Employing Oxy-acetylene Flame

A change-gear actuated roll motion of the work-head causes the burners to follow the curved teeth on spiral bevel and helical gears. The change-gears required to obtain any desired roll within the range of the machine are furnished as part of the equipment. When hardening straight teeth, the roll motion is locked out of action. A mechanical hydraulic system operated by a hydraulic pump controls the motions of the burners, the index, and the roll. Water lines are provided for quenching the teeth and cooling the body of the gear. A non-rusting coolant is used to eliminate discoloration of the gear.

A variable rate of travel of the burner slide is provided to give, first, a progressively increasing or decreasing velocity to compensate for the continuous change in tooth section—in a bevel gear—and for the heat accumulation ahead of the burners; and second, a speed-up over the ends of the teeth at the termination of the hardening stroke. Simple adjustments are provided for setting the stroke speeds.

The hardening operation is completely automatic. The operator has only to chuck the gear with the aid of a simple stock dividing gage, press the starter and gas buttons, and ignite the burners. The machine will then automatically index, roll, preheat and harden the teeth, stop the motor, and shut off the gas when all the teeth in the gear have been hardened.

The set-up of the machine is simple. After the index, roll, and stroke have been determined, the proper change-gears are selected from tables furnished with the machine. Straight-line cams are provided to guide the direction of the travel of the burners. The set-up time on repeat jobs can be reduced by making a record of the various settings on the machine. 52

"Laminum" Shim Stock

"Laminum" shim stock, made by the Laminated Shim Co., Inc., Glenbrook, Conn., can now be furnished in sheets of 7 by 36 inches, in addition to the 6- by 36-inch sheets previously manufactured. The new width permits the company to make larger jointless shims.

The new sheets are available in over-all thicknesses of from 0.006 to 0.125 inch. All thicknesses can be obtained in all-laminated sheets with a choice of 0.002- or 0.003-inch laminations, or various thicknesses can be had in partly laminated and partly solid types. 53

To obtain additional information on equipment described on this page, see lower part of page 154.

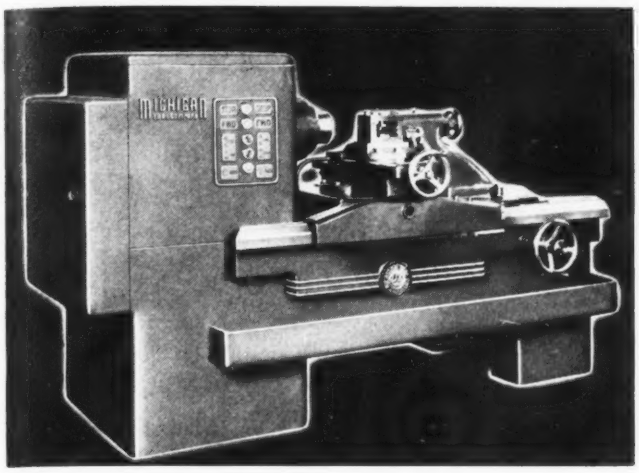


Fig. 1. Cutter Relieving Machine Developed by Michigan Tool Co.

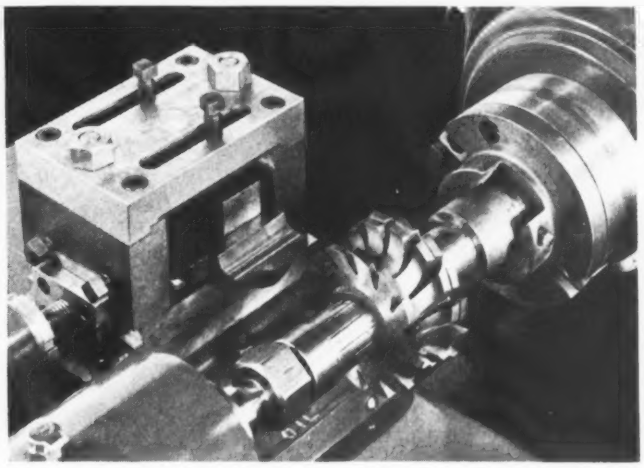


Fig. 2. Set-up Employed for Relieving Special Form Cutter

Michigan Universal Cutter Relieving Machine

A universal cutter relieving machine designed to simplify and speed up the manufacture of rotary cutting tools of various types has been developed by the Michigan Tool Co., 7171 E. McNichols Road, Detroit, Mich. This machine, shown in Fig. 1, is suitable for relieving forming cutters, gear and rack cutting tools, end-milling cutters, spot-facers, etc., with radial or side relief, or both. It was developed from machines used by this company to produce its own line of Mitco cutters and other tools. Included in the design are several new features, such as multiple range of forward and reverse speeds to handle virtually all forms of work at maximum efficiency; turntable for cam slide, permitting relieving from any angle; universal adjustable tool-box for quick set-up; quick interchangeable cams; and lubrication from reservoirs with inspection portholes.

The machine will handle work up to 8 inches in diameter, with a maximum length between centers of 24 inches. Gears with any number of teeth from 1 to 24 can be relieved. The maximum relieving stroke is 3/4 inch. Five relief cams are furnished with the machine. The speed changes, both forward and reverse, are obtained through electrical control. Two reversible motors are coupled in such a manner that, by operating either one or both motors, seven spindle speeds are obtained—four forward and three reverse. These speeds can be changed while the machine is running. In Fig. 2 is shown a set-up for relieving the special form cutter seen mounted on the mandrel. 54

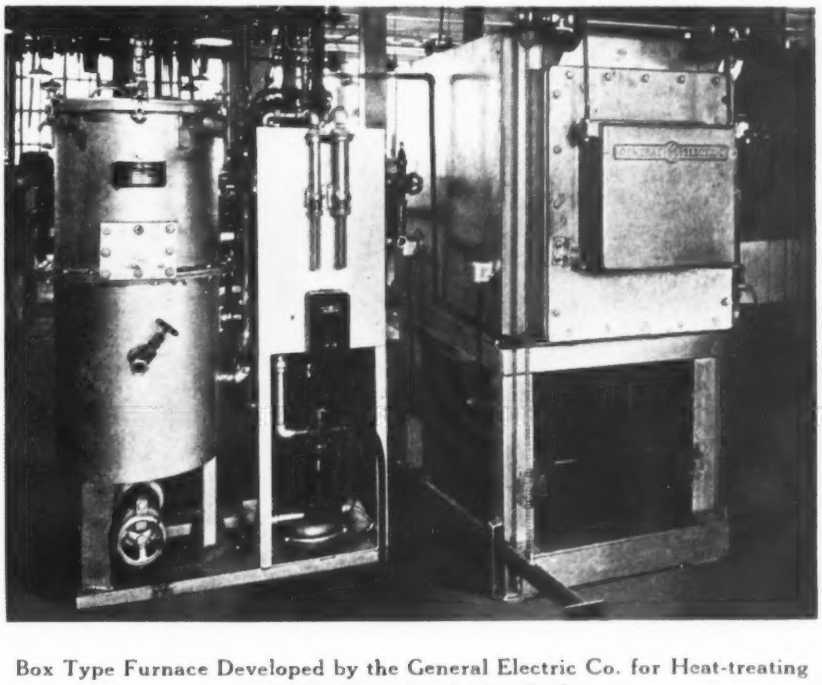
General Electric Heat-Treating Furnaces for Tools and Small Parts

A new line of box type furnaces for heat-treating steel without producing scale or decarburization has been brought out for use in the machine tool industry by the General Electric Co., Schenectady, N. Y. The furnaces can also be used in other industries where small steel parts must be heat-treated at temperatures up to 2000 degrees F.

The furnaces are designed especially for use with drycolene atmosphere gas, developed recently by the General Electric Co. for heat-treating metals without decarburization or scale. Atmospheres other than drycolene can be used, however, the amount of scale and decarburization then depending upon the type of atmosphere used.

There are four furnaces in the new box type line; three of these are similar, while the fourth, or largest, differs in that the door is motor-operated instead of being operated by a foot-pedal. Each furnace consists of a light-weight refractory lining backed up by heat-insulating material, all enclosed in a welded gas-tight sheet-steel casing. The door and furnace front are of cast iron, machined to insure a close fit.

A high-velocity flame curtain prevents the furnace from losing its atmosphere when the door is opened. A unique feature of the curtain is



Box Type Furnace Developed by the General Electric Co. for Heat-treating Steel without Producing Scale

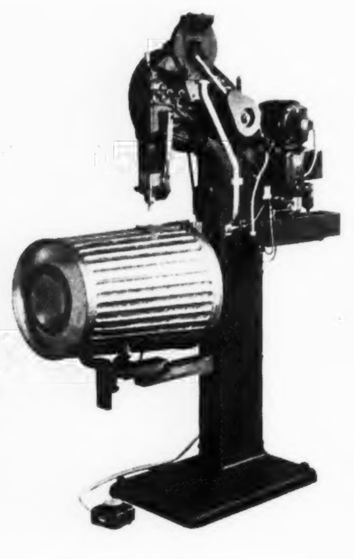
To obtain additional information on equipment described on this page, see lower part of page 154.

the mounting of the gas burner at the top of the furnace, so that the flame curtain is shot down over the door opening, thus preventing dirt from dropping into and clogging the gas burner.

Uniform temperature is maintained by compensating heating units in the front and rear of the furnace and automatically controlled power input to the main heating unit. The furnace known as Type 1227, has an internal width of 12 inches, a working length of 27 inches, and a door height of 8 inches; the corresponding dimensions of Type 1530 are 15, 30, and 10 inches; and of Type 1836, 18, 36, and 13 inches. Type 2754 has an internal width of 27 inches, a working length of 54 inches, and a door height of 20 inches. 55

Automatic Riveting Machine

The Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich., has brought out an automatic riveting



Tomkins-Johnson Riveting Machine

machine designated the "Rivet-Pierce Rivitor." This machine drives the previously unpierced work down over the rivet, punching a slug out of the work. The rivet is then "set" at the next stroke of the machine. At the end of the riveting stroke, the transfer ram cylinder carries a rivet from the track leading from the hopper to the under side of the work, and leaves it in the "fingers" of the anvil. Thus, a rivet is fed in this manner at every other stroke of the ram.

A spotlight which directs a beam of light at the rivet serves to indicate at the top side of the work the location of the rivet beneath. The diameter of the "spot" may be set to the diameter of the rivet for which the machine is tooled, the capacity range being for rivets from 1/16 to 0.140 inch in diameter.

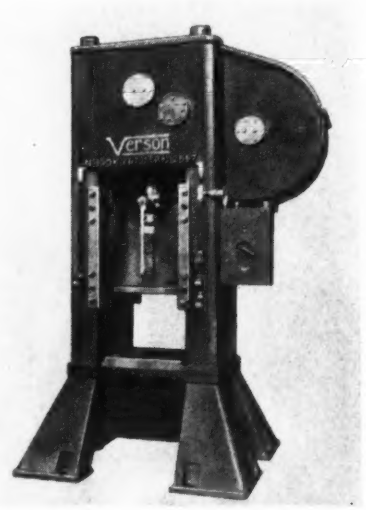
The slug punched from the work escapes through a hole in the front of the head. The head is automatically indexed or reversed 90 degrees on the up stroke to bring the riveting head into position. As the ram ascends after heading the rivet, the machine head is again reversed to bring the piercing die into position for the next piercing stroke. The work, of course, remains in the same position for the piercing and the riveting operations.

The particular machine shown in the illustration is equipped with fixtures that serve to hold the work in the correct piercing and riveting position. Work-supports can be designed to suit the particular piece handled. The machine operates at the rate of 190 strokes per minute. The machine is made in three different throat-depth capacities—8, 12, and 14 inches. The ram stroke is 3 inches, and the flywheel speed 190 R.P.M. The 1/2-H.P. motor has a speed of 1725 R.P.M. The 12-inch throat machine occupies a floor space of 22 by 46 inches, and weighs 1300 pounds. 56

Verson Allsteel Knuckle-Joint Press

A new type knuckle-joint press has been added to the line of forging and stamping presses built by the Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago, Ill. This new press is designed to provide a long stroke and a wide range of adjustment without sacrificing the desirable knuckle action of the more common type of knuckle-joint and embossing presses.

The press is available in a full range of tonnage capacities. The size shown in the illustration has a capacity of 150 tons, a 5-inch stroke, and a 5 1/2-inch adjustment. The bed area is 26 by 26 inches, and the press is operated at a speed of 50 strokes per minute. It is equipped with a full pneumatic clutch and brake unit having electrical push-button control for automatic operation. The frame

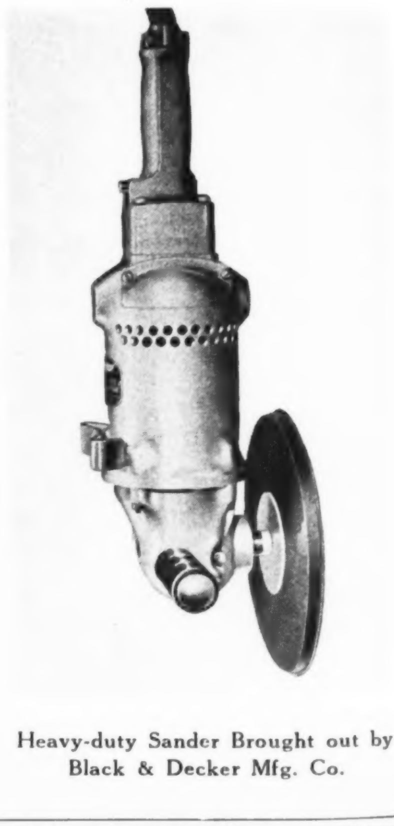


Verson Allsteel Press of 150 Tons Capacity

is of fabricated steel construction, designed to provide maximum stiffness with a high factor of safety. Various types of feed can be adapted to this press. 57

Black & Decker Heavy-Duty Sander

A heavy-duty sander designed for constant production-line use with 9-inch abrasive disks has been added to the line of tools made by the Black & Decker Mfg. Co., Towson, Md. The universal motor and new spindle lock for quick disk-changing are



Heavy-duty Sander Brought out by Black & Decker Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 154.

features of this sander designed to speed up metal-surfacing work.

The no-load spindle speed is 5000 R.P.M., the over-all length 19 1/2 inches, and the weight 18 3/4 pounds. 58

Westinghouse Multi-Breaker

A multi-breaker for any normal-duty application that would otherwise require fuses or fuse-equipped switches has been brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This breaker is available in two types, the M-1 and M-2. These 15- to 100-ampere, two- or three-pole breakers are intended for use on alternating-current

Westinghouse Fuseless Multi-breaker

circuits up to 230 volts. The sheet-steel dust-resistant enclosure has ten concentric knock-outs for conduit or cable connections.

In operation, a bimetal thermal element actuated by overload or short circuit causes the breaker to trip. However, while the breaker trips immediately on short circuit or dangerous overload, an inverse-time characteristic allows it to remain closed during temporary harmless overloads. An indicator shows when the multi-breaker is tripped. 59

Light-Weight Flexible Air Hose

A light-weight air hose, made in 1/2- and 3/4-inch sizes, that is so flexible that the 1/2-inch size can be bent to a 3-inch radius without collapsing or cutting off the air supply has been placed on the market by the B. F. Goodrich Co., Akron, Ohio. This hose has been designed to combine strength and efficiency with minimum weight and ease of handling. It is particularly adapted for use with pneumatic tools. The two-braid construction can easily withstand working pressures of from 80 to 125 pounds, the safety factor being more than 5 to 1 under a working pressure of 125 pounds. 60

Cabinet Pedestal for Bench Type Drill Grinder

William Sellers & Co., Inc., Philadelphia, Pa., has brought out a pedestal or cabinet with a work space approximately 13 inches wide by 30 inches long on which the bench type drill grinder of this company's manufacture can be mounted. The top of the pedestal is approximately 31 inches from the floor.

Cabinet Pedestal for Drill Grinder Made by William Sellers & Co.

The main pedestal is constructed of sheet steel, sufficiently heavy and braced to form a vibrationless mount for the machine. A hinged steel door, with fastener, provides access to the storage base for attachments and supplies. The top and shelves are made of suitable material, preferably wood, to absorb vibration and avoid marring tools and attachments. The weight of the pedestal is about 175 pounds. 61

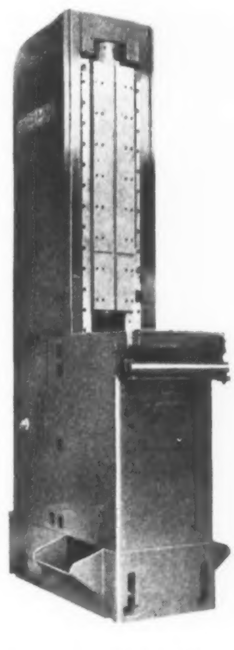
Colonial Single-Ram Broaching Machines

Work-tables and rams of larger size and new streamline design are features of an improved standard line of single-ram broaching machines now being introduced on the market by the Colonial Broach Co., 147 Jos. Campau Ave., Detroit, Mich. Each machine of this line is adapted to a wider range of tooling than previous models. Peak capacities have been increased to give ample reserve power when operating at normal rated capacities. The normal capacities of the eleven standard models range from 3 tons and 36-inch stroke up to 25 tons and 66-inch stroke.

The column widths have been increased, giving better support for the wide bars frequently handled. The work-platen has also been made wider. The main drive motor is now mounted inside the column.

Improvements in the receding table mechanism provide for the installation of chip wipers, which protect the bearing surfaces of the moving platen. Finish-machined pads are now provided on the front, as well as on both sides, of the table for mounting auxiliary units, such as cams, used to automatically operate clamps. The pads are also used to support jacks on the fixtures.

Both dual safety control and emergency knee bar for stopping the machine quickly are supplied. All machines are hydraulically controlled. The automatic force-feed lubrication system for the receding table bearings and the ram bearings has also been improved. A sight-gage for the lubrication system is mounted on the face of the column above the platen.



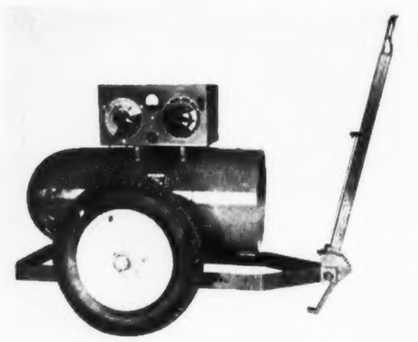
Colonial Broaching Machine Built in Eleven Models

To obtain additional information on equipment described on this page, see lower part of page 154.

Greater chip room and coolant capacity have been obtained in the new machine without increasing their over-all height. All machines are equipped with heavy-duty, large-volume coolant pumps. 62

Lincoln Two-Wheeled Trailer for Welding Machine

A two-wheeled, light-weight, pneumatic-tired trailer on which arc-welding machines can be mounted to facilitate rapid movement in the shop, yard, or on the road, has just been brought out by the Lincoln Electric Co., 12818 Coit Road, Cleveland, Ohio. Either Lincoln SAE 200- to 600-ampere, alternating-current, motor-driven arc welders or Type SA 200 special engine-driven arc welders like the one shown in the accompanying illustration can be mounted on the trailer for road-towing at speeds up to approximately 30 miles per hour. The trailer can be hitched to an industrial truck, and can be easily removed by hand. It is of low underslung design, with a narrow 31-inch tread, and is of arc-welded steel construction throughout.

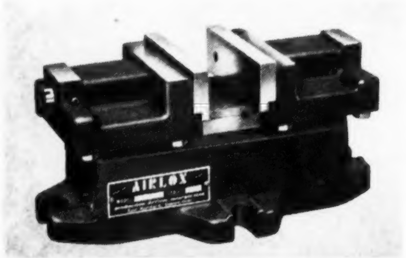


Lincoln Trailer for Welding Machine

The combination tow-bar and standing support has a hand-operated ratchet arrangement for locking the support arm in position. The complete unit is 66 inches long, 42 inches wide, 16 inches high, and weighs 282 pounds. The tires are 16-inch by 5.50-inch, four-ply. 63

Air-Operated Vise

Production Devices, Inc., 213 Comstock Bldg., East Hartford, Conn., have recently introduced on the market an air-operated vise known as the "Airlox Junior." This vise is so constructed that all gripping is done over the approximate center of the vise. The mechanism is enclosed within the vise body, and thus is shielded from any contact with chips, dirt, coolants, etc.



Air-operated Vise Made by Production Devices, Inc.

The vises are regularly supplied with No. 1 B & S jaw-hole spacing and soft jaw faces. They can also be provided with undrilled jaw castings for fitting to jig faces. The opening and closing movements of the jaws can be synchronized with the movements of a milling machine table or drill press spindle, thereby eliminating all manual operation of the vise. The over-all dimensions are: Length, 10 inches; width, 5 7/8 inches; and height, 4 3/4 inches. The maximum opening between the jaws is 2 1/8 inches, and between the jaw faces, 3 inches. The weight is approximately 25 pounds. 64

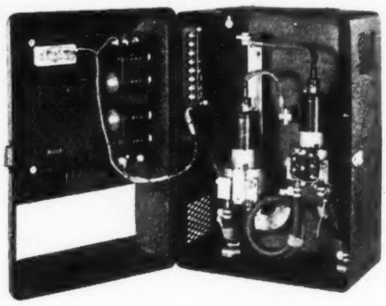
Aro High-Speed Turbine Type Grinder

Among the new tools recently added to the line made by the Aro Equipment Corporation, 115 Madison St., Bryan, Ohio, is a high-speed, pneumatic, turbine type grinder which attains a spindle speed of 80,000 R.P.M. with wheels up to 3/8 inch in diameter. This tool is light and small, and can be held in the hand like a pencil or mounted for toolpost grinding operations. 65

Aro High-speed Pneumatic Grinder

Electronic Welding Contactor

An electronic welding contactor for use with timing equipment employed in spot-welders is being placed on the market by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This unit, known as the SW 150 Weld-O-Trol, is designed for spot-welding applications. The welding current is handled at an extremely high rate of interruption by two heavy-duty, water-cooled ignitron tubes. The tubes are held by water-cooled clamps made of copper tubing cast in a heat-conducting alloy. Provisions are made for the removal of tubes without disturbing the water connections. A thermostat mounted on the cooling clamps protects the tubes against high temperatures that may be caused by failure in the water supply.



Westinghouse Electronic Welding Contactor

All auxiliary controls are mounted inside the Weld-O-Trol steel cabinet door to permit accessibility and yet allow physical separation from the power circuit. Ample space is provided for power and control leads. This unit is readily adapted for use with heat control and with either synchronous or non-synchronous weld timers, including sequence controlling equipment. 66

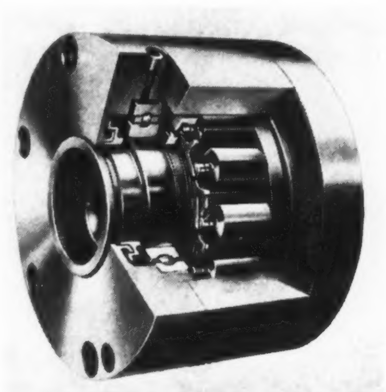
Morse Indexing and Free-Wheeling Clutches

The indexing and free-wheeling clutch manufactured by the Morse Chain Co., Ithaca, N. Y., is now available in twelve standard sizes with torque capacities ranging from 26 to 6300 foot-pounds. This clutch, designed as shown in the accompanying illustration, is, in effect, a self-contained ratchet having an infinite

To obtain additional information on equipment described on this page, see lower part of page 154.

number of teeth. It is particularly suited for use as a ratchet for various feed mechanisms, and has been designed to provide positive indexing control for practically every type of ratcheting operation. It is being used extensively on various roll-feeding installations for feeding steel, rubber, leather, and felt stocks in a wide range of sizes, and in round, square, triangular, flat, and rectangular shapes.

The uniform and accurate indexing of loads permits a high rate of feed and provides closer punching and more pieces per given length of stock with less scrap. Varying the speed and adjusting the length of the index strokes to accommodate



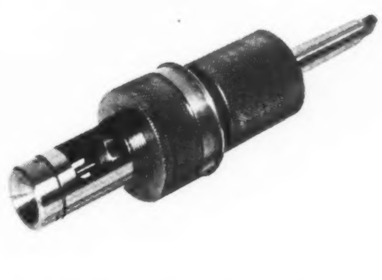
Free-wheeling Clutch Used as a Ratchet in Feeding Mechanisms

different kinds of stocks is accomplished by one machine adjustment.

Power is transmitted from an inner hub or driving member by a system of positive gear-actuated cams. These closely spaced cams are moved into and out of engagement smoothly and instantaneously, yet they are as positive in action as a gear. 67

Centering Chuck

The Universal Engineering Co., Frankenmuth, Mich., has brought out a new tool known as a centering chuck, which, it is claimed, enables any medium-sized drill press to be employed as a centering machine. Bushings beveled at an angle of 45 degrees form a conical surface that fits over the ends of the shafts to be centered. The chucks are furnished with a set of collets and bushings to fit the various sizes of center drills. The cone locates the shaft centrally and the bushing guides the center drill. There is a feed-out adjustment on the chuck for regulating the depth of the cen-



Centering Chuck Made by the Universal Engineering Co.

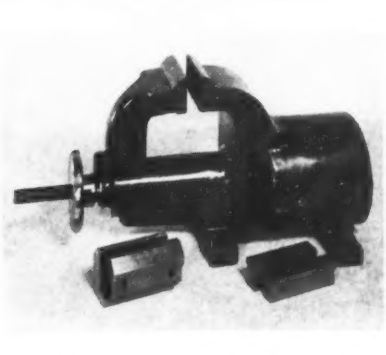
ter-drilling operation, so that all centers will be of uniform depth. With this arrangement, it is only necessary to chamfer the burrs from the shaft in order to hold the centers to a uniform depth within a few thousandths inch.

Screw machine work that has been centered in one end can be set on a drill press with a center point, so that the opposite end can be centered quickly. A convenient arrangement is provided for quickly removing center drills and guide bushings. 68

Fastmatic Vise

A vise in which smooth and rapid jaw traverse is obtained through an oil- or air-pressure operated piston, directly connected to the sliding jaw member, has recently been brought out by the Fastmatic Vise Co., 120 Boylston St., Boston, Mass. The holding power between the fixed and movable jaws is regulated by the piston pressure. Air pressure at 80 to 100 pounds is usually taken from the air supply system. Air pressure from the pumps on individual machines or from independent hydraulic pumps can also be employed.

The movement of the piston is approximately 1 inch. Various sizes of work are accommodated by setting the jaw in an initial position to suit the spacing desired by means of the



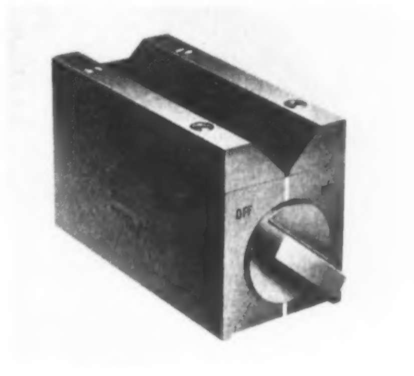
Fastmatic Vise Operated by Oil or Air Pressure

adjusting screw on the front end of the vise. For repetitive work, the original setting is maintained and the 1-inch movement employed in opening and closing the jaws.

The jaw movement is controlled by a valve which can be operated either by hand or foot, although the latter is generally preferred, since it allows both hands of the workman to be free. The vise is available with a variety of hardened, soft, or formed jaws, and in a number of sizes. 69

B & S Magnetic V-Block

The Brown & Sharpe Mfg. Co., Providence, R. I., has recently added a magnetic V-block—the No. 750D—



B & S Magnetic V-block of Permanent-magnet Type

to its line of precision tools. This new V-block is of the permanent-magnet type. It is of a small and convenient size, with a width of 2 1/2 inches, a height of 3 1/2 inches, and a length of 6 1/4 inches over all. The vee has a capacity for holding work up to 1 3/4 inches in diameter. Iron or steel work of round or rectangular cross-section, as well as irregular-shaped pieces, can be held between and in contact with the sides of the V-groove. This block can be used for both wet and dry grinding.

When the control knob is turned to the "on" position, the work is held firmly in the vee, and, if the V-block rests on a magnetically conductive surface, it is also held firmly to this surface. The work and V-block are both released when the control is turned off. The holding power can be regulated by giving the control knob a part turn, so that the work can be removed from or positioned in the vee without releasing the block from the conductive surface.

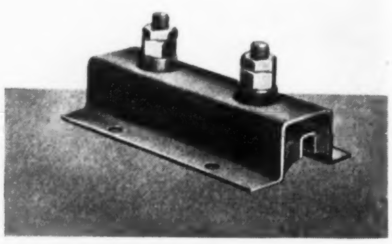
The magnetic pull on the end of the V-block permits it to be held in

To obtain additional information on equipment described on this page, see lower part of page 154.

an upright position on a magnetically conductive surface, as well as in the horizontal position. It does not become heated under any conditions, and the control can be left on as long as desired without damage to the block or work. The V-block has only one movable part, the magnet, which is made of a special alloy developed to retain its holding power indefinitely. This magnetic block is offered for sale only in the United States and its Territories. 70

Korfund Vibration-Insulating Machine Mountings

In addition to the line of natural-cork and steel-spring resilient mountings for reciprocating and rotating machinery, the Korfund Co., Inc., Long Island City, N. Y.,



Vibration-insulating Mounting Made by Korfund Co., Inc.

is now making several types of vibration insulators employing rubber as a cushioning medium. These mountings are particularly adapted for use in small-engine and relatively light-weight machinery installations.

Load capacities for individual units range from 25 to 450 pounds. If necessary, two or more of these mountings can be combined in steel housings when greater load capacities are required. The circular compression type of mounting (not shown) is suitable for concentrated loads. Both the top and bottom steel sections of this type of mounting are securely bonded to the circular rubber stock. Load capacities range up to 1200 pounds per mounting. If desired, this unit can also be used as a shear-mounting by bolting the baseplate in a vertical position.

Korfund rubber mountings are also available in extended structural integral bases. Thus a common sub-base for driving and driven machinery can be provided with which accurate alignment between two machines can be maintained. No other integral base is necessary, and uniform load distribution is attained by correctly spacing the isolators within the steel members. 71

Thor Extra-Light Riveting Hammer

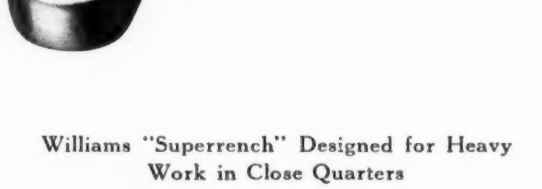
An extra-light pneumatic riveting hammer, designated the 3-Z, which is designed for driving 5/32-inch Dural rivets in the assembling of certain light types of aircraft, has been brought out by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. This riveter is of the "slow-hitting" hammer type, built for efficient operation and sustained uniformity of power over a long period.

It will also drive 3/32-inch soft iron and 3/16-inch aluminum rivets. The riveting hammer has a 3/8-inch bore and a 3-inch stroke, and is made with five different styles of handles. 72

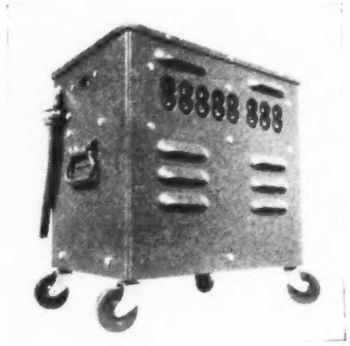
Williams Striking-Face "Superrench"

J. H. Williams & Co., 225 Lafayette St., New York City, have recently added a new wrench to their line of "Superrenches." This wrench is particularly adapted for heavy work in close quarters where large nuts must be set up tight or "frozen" nuts must be loosened. The offset head provides ample clearance.

The wrench is available in ten sizes with twelve-point openings, 1 1/16 to 2 3/4 inches for U. S. Standard nuts in sizes from 5/8 inch to 1 3/4 inches. It is drop-forged from chromium-molybdenum steel, and heat-treated to withstand hammer blows on the striking faces of the box-shaped end. The finish is baked gray enamel. 73



Williams "Superrench" Designed for Heavy Work in Close Quarters



Flexarc Welder Built by Westinghouse Electric & Mfg. Co.

"Midget Marvel" Flexarc Welder

The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has brought out a Flexarc welder known as the "Midget Marvel WT-1" for use in welding light-gage metal, castings, and drive-shafts, and for general maintenance and light production work. This alternating-current welder is furnished complete with all accessories, including primary cable for connection with the power line, electrode lead and holder, work lid, helmet, and a supply of electrodes.

Sensitive adjustment of the welding current over a range of from 20 to 140 amperes is provided. The full-load rating is 110 amperes, 30 minutes, 30 load volts, when used on 220-volt, 60-cycle lines. The unit is approximately 14 1/2 by 12 1/8 by 20 inches in size, weighs 160 pounds, and is supported on casters. 74

"Univertical" High-Speed End-Milling Machine

A compact, vertical type, high-speed end-milling machine known as the "Univertical," which can be used for such operations as drilling, boring, contour milling and light grinding, has been brought out by the Univertical Machine Co., 620 St. Antoine St., Detroit, Mich. The swivel head is graduated to a range of adjustment 90 degrees right or left of the vertical position. Precision milling operations on intricate work can be performed by the adjustable head, which has four spindle speeds ranging from 850 to 3400 R.P.M.

The spindle collet has a capacity for holding

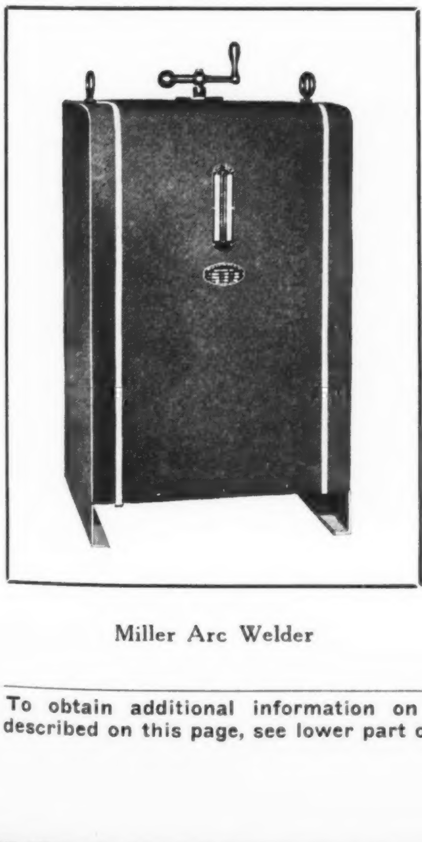
To obtain additional information on equipment described on this page, see lower part of page 154.

straight-shank cutting tools from 1/8 to 5/8 inch in diameter. The table is 24 by 4 7/8 inches, and has two 1/2-inch wide slots. It has a longitudinal travel of 17 inches, a cross travel of 7 inches, and a vertical travel of 10 inches. All table movements are graduated to 0.001 inch. The distance from the center of the spindle to the column is 6 1/2 inches. The 1/4-H.P., heavy-duty, ball-bearing motor has a speed of 1730 R.P.M. and operates on 60-cycle current. It is adapted for either 110 or 220 volts. The bench model has an over-all height of 44 inches, while the floor model has an over-all height of 70 inches.......75

Miller Industrial Type Welders

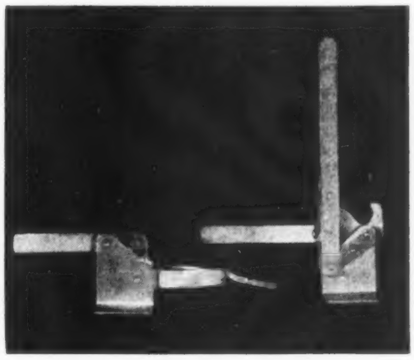
Four models of industrial type welders, designed for manual or automatic production welding, are available in a new line brought out by the Miller Electric Mfg. Co., Inc., Appleton, Wis. These welders are of the transformer type with built-in power factor correction, designed to reduce current consumption. They answer a twofold purpose for, when not in use as arc-welders, they can be employed to correct the power factor of existing installations, and thus reduce heating of the power circuit.

The welders are built to conform to the N.E.M.A. standards, and employ Class B insulation—that is, asbestos and Fiberglas. The welders have two open-circuit voltages of 80 and 100 volts. This permits the operator to choose the correct voltage for the work being performed. The higher voltage is an advantage when welding with alloy electrodes, giving a smoother, more stable arc. The lower voltage is sufficient, however, for all general work.



Miller Arc Welder

The amperages shown by the indicator at the front of the cabinet can be adjusted without breaking the arc by simply turning the ball-crank handle. With these alternating-current welders, difficulty with magnetic blow, slag pockets, or grain structure is eliminated, and strong, dense welds are obtained. The welders are built in 300-, 400-, 500-, and 600-ampere sizes.......76



Jig Clamps Brought out by Products Engineering Co.

"Peco" Jig Clamps

A line of high-leverage, quick-acting jig clamps has just been placed on the market by Products Engineering Co., 416 S. Robertson Blvd., Los Angeles, Calif. The complete line of five clamps, made in various sizes, has been designed to meet practically all manufacturing, fabricating, and tool requirements. The clamps consist of combinations of hot- and cold-rolled steel pieces.

The quick-action clamp shown at the left in the illustration is made in large, medium, and small sizes for light-duty drill and assembly jigs. The second type (not shown) is a jig draw-clamp for tightening or stretching formed sheet material over a drill or trim jig to insure accurate alignment.

The third, or knife type, clamp is designed for powerful clamping action on two-part jigs. An eccentric arrangement allows 1/8 inch adjustment for distortion due to welding. After adjustment, the eccentric can be tack-welded for security and rough usage. The fourth type is a toggle clamp made in five sizes. The lower member can be bent to the shape required to clear obstacles and to reach the desired position.

The fifth type, shown at the right in the illustration, is made in five sizes and is designed for a large variety of applications on jigs and fixtures.......77

* * *

Windowless or "Blackout" Factories Increasing in Number

A one-story windowless "blackout" factory of 225,000 square feet of floor space, to be used by the General Electric Co. for the manufacture of superchargers for military airplanes, has just been erected at Everett, near Lynn, Mass. The plant, having no daylight, is uniformly lighted by fluorescent lamps which come the nearest of any artificial source of light to duplicating the rays of the sun. The working space is lighted uniformly with 50 foot-candles of light throughout the plant, thus eliminating shadows.

The plant is also air-conditioned, so that on the hottest days in summer, the temperature will be at least 12 degrees lower inside the building than outside. Approximately 100,000 cubic feet of fresh air per minute, four times that required by the State health authorities, is circulated by means of large ducts to all parts of the building every hour. The uniform temperature in the buildings is of importance because of the character of the product manufactured which, in certain instances, is required to be finished to limits of 0.0001 inch. For such precision manufacture, sudden changes in temperature would be undesirable.

* * *

Machine Tool Production Continues to Increase

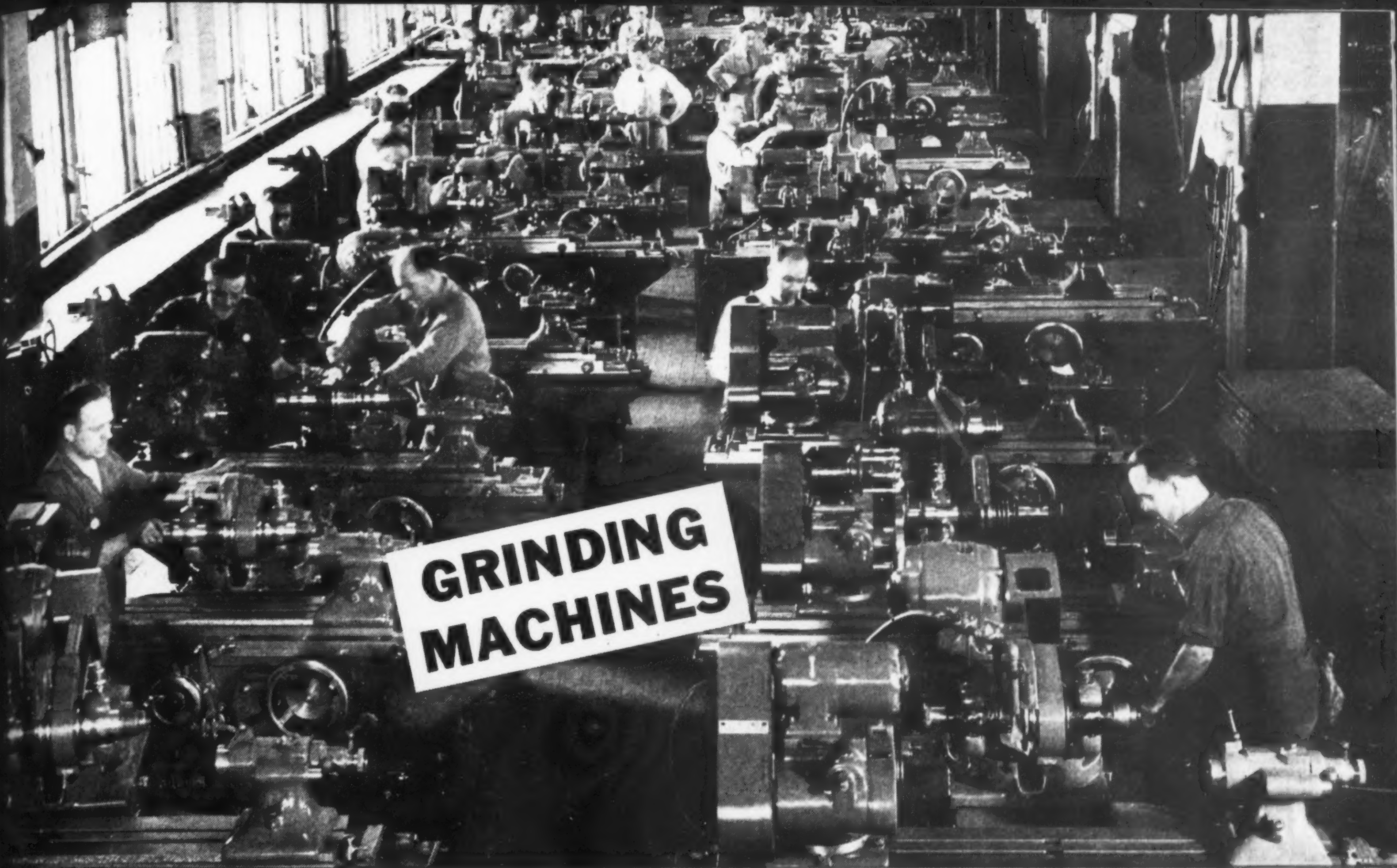
Machine tool shipments for June increased to $63,400,000, compared with $60,800,000 for May of this year and $34,000,000 for June, 1940. This is at the rate of $760,000,000 a year, which means that, since shipments are expected to continue to mount steadily, the total production for 1941 is likely to exceed the previously announced goal of $750,000,000. According to the National Machine Tool Builders' Association, the entire production of the industry is now devoted to national defense purposes and aid to Britain. The industry has practically doubled its rate of production within the last twelve months.

To obtain additional information on equipment described on this page, see lower part of page 154.

-IN EVER INCREASING QUANTITIES

For Urgent National Defense Production . . . Today

BROWN &


GRINDING
MACHINES


SCREW
MACHINES
. . with Accuracy
and Dependability
to serve Profitably
on Future Needs in
Manufacturing

SHARPE

Means to Prevent a Shortage in Nickel

According to D. A. Uebelacker, of the Nickel Section of the Office of Production Management, the current demand for nickel each month is in the neighborhood of 21,000,000 pounds, of which about 12,500,000 pounds are for defense requirements. As the amount of nickel available at the present time is about 15,000,000 pounds a month, this leaves a deficiency of approximately 6,000,000 pounds monthly. It is hoped that this deficiency can be made up in large part through the proper conservation and return to the nickel producers of nickel steel and other nickel-alloy scrap. It is of importance that users of nickel steel segregate and classify their scrap, so that the nickel can be effectively recovered.

In a letter sent out by the Office of Production Management, the following statements were made:

"To assure an adequate supply of alloying elements for the production of alloy iron and steel in carrying out the Defense Program, it is necessary that prompt steps be taken to more completely conserve the alloy content of alloy iron and steel scrap.

"In many manufacturing plants at least 20 to 40 per cent of the alloy steel delivered by steel producers or distributors is lost as scrap during conversion into finished products, and in some industries this scrap loss runs as high as 70 or 80 per cent. Much of the alloy content of such scrap is at present being permanently lost for alloying use when it becomes mixed with other steel or metal scrap. This is particularly true in the case of machine turnings or chips, forgings, flashings, etc., and to a lesser extent in the case of heavier melting scrap, such as bar ends, large punchings and rejections. A similar situation exists in plants using alloy irons. The Office of Production Management, accordingly, requests all manufacturers processing alloy iron and steels to take prompt steps to insure the proper segregation and identification of their scrap and the return of such scrap in acceptable and usable form free from contamination, either direct to their suppliers or to their scrap-metal dealers.

"As far as steel scrap is concerned, the following grouping is suggested for proper utilization:

(1) Chrome-nickel base alloys should be graded according to their content of nickel, carbon, stabilizing elements and elements added for machinability.

(a) Nickel: Over 1 to 7 per cent; over 7 to 10 per cent; over 10 to 22 per cent.

(b) Carbon: 0.08 per cent maximum; over 0.08 per cent.

(c) Stabilizing elements: Each alloy such as molybdenum, titanium, and columbium should be kept separate.

(d) Elements added for machinability.

1. Sulphur, phosphorus, and selenium, each 0.035 per cent maximum.

2. Sulphur, phosphorus, and selenium, any one over 0.035 per cent; each element should be kept separate.

(2) Chromium-base alloys.

(a) Chromium: 12 to 14 per cent; over 14 to 18 per cent; over 18 per cent.

(b) Carbon: 0.15 per cent maximum; over 0.15 per cent.

(c) Elements added for machinability.

1. Sulphur, phosphorus, and selenium, each 0.035 per cent maximum.

2. Sulphur, phosphorus, and selenium, any one over 0.035 per cent.

"Lower alloy content grades of steel should be similarly segregated and identified by alloy content, in the following suggested groups:

Group 1—2500 series (4.75 to 5.25 per cent nickel). If available only in small quantity, mix with Group 1-A.

Group 1-A—2300 series (3.25 to 3.75 per cent nickel). If available only in small quantity, mix with Group 1.

Group 2—3300 series (3.25 to 3.75 per cent nickel; 1.25 to 1.75 per cent chromium).

3400 series (2.75 to 3.25 per cent nickel; 0.60 to 0.95 per cent chromium). If available only in small quantity, mix with Group 4.

Group 2-A—3200 series (1.50 to 2.00 per cent nickel; 0.90 to 1.25 per cent chromium).

3100 series (1.00 to 1.50 per cent nickel; 0.45 to 0.75 per cent chromium). The steels in this series should be segregated individually if available in quantity; otherwise, this group is intended to apply in general to low nickel content (2 per cent and under) steel scrap.

Group 3—4800 series (3.25 to 3.75 per cent nickel; 0.20 to 0.30 per cent molybdenum). If available only in small quantity, mix with Group 3-A, Group 2, or Group 4, according to which group of scrap predominates, and in the order of preference stated.

Group 3-A—4600 series (1.65 to 2.00 per cent nickel; 0.20 to 0.30 per cent molybdenum). If available only in small quantity, mix with Group 3 or Group 4.

Group 4—4300 series (1.65 to 2.00 per cent nickel; 0.60 per cent chromium; 0.20 to 0.30 per cent molybdenum). Other combinations of nickel, chromium, molybdenum, or nickel, chromium, molybdenum, vanadium are included in this group.

Group 5—4100 series (0.45 to 1.10 per cent chromium; 0.15 to 0.30 per cent molybdenum).

Group 6—6100 series (0.80 to 1.10 per cent chromium; 0.10 per cent minimum vanadium).

Group 7—5100 series (0.50 to 1.20 per cent chromium).

Group 7-A—5200 series (0.45 to 1.65 per cent chromium; 0.90 to 1.15 per cent carbon).

Group 8—4000 series and other carbon-molybdenum steels (0.15 per cent minimum molybdenum).

Group 9—Chromium-molybdenum oil-refinery scrap.

"When higher alloy content grades are mixed with those of lower alloy content, the calculated recovery of alloy in remelting at the steel mill is lowered, and the best utilization of the scrap is therefore impaired.

"Alloy scrap of special chemistry not covered by the foregoing standardized grades should be segregated and returned to the maker or disposal arrangement made on his advice.

"The proper segregation and identification of the various grades of heavy melting scrap is largely a matter of supervision and provision for adequate storage space, but light scrap such as turnings or chips involves baling or briquetting, as well as crushing or washing, if the cutting oil is to be recovered. Many plants should find it feasible to install salvaging equipment to carry out these operations. In any event, it is recommended that every plant consult with its steel supplier as to the most appropriate measures to be adopted to assure that all alloy scrap is salvaged in a condition which will permit conservation and use of its alloy content."

Important Part Played by Metal-Spraying in Repair Work

The use of metal-spraying to effect quick, durable repairs where intensive corrosion and wear have taken their toll can now be said to be a thoroughly tried and tested procedure, resulting in considerable savings in time and in replacement of equipment. In many plants, this method of building up worn surfaces and covering those attacked by corrosion has been used over a period of years. Almost every kind of metal can be sprayed, in addition to hard rubber, synthetic rubber, and glass.

By far the larger number of repairs, however, are made with relatively few materials—zinc and tin alloys, stainless steel, manganese bronze, and hard rubber. Large, corroded tanks, worn shafts, and many other parts that have been subjected to severe service are frequently salvaged in this way.

One of the most general applications of metal-spraying is in the building up of worn journals of shafts. This, in fact, was one of the early applications of the method. In one case, the shaft of a coal crusher was repaired in this manner. The shaft was made of steel, the attached impeller of brass, and the casting of cast iron. The shaft had been subject to considerable corrosion from electrolytic action, as well as wear. It was removed and a length of about 8 inches of bearing surface was sprayed with stainless steel. Then the shaft was turned down to the correct size, the bearing ground, and the equipment put back into service. It has now been in operation for over five years, and there are no appreciable signs of wear. The repair cost was about $75, whereas a new shaft would have cost approximately $400.

In another case, the rotor of a centrifugal machine was badly worn on an end bearing surface. Stainless steel was used in this case, also, for spraying over an angular area 25 inches in circumference by 1 1/2 inches wide. The time required for repairs was five hours—two hours for the preparatory sanding and spraying; one hour for machining; and two hours for grinding. A new shaft would have cost $110.

The actual spraying operation is not difficult to learn, but since it is an art, the amount of air pressure, the size of the flame, and the amount of deposit to be sprayed are all factors that must be learned by experience. A few safeguards are necessary to insure satisfactory results. After sand-blasting, the surface to be sprayed must be carefully protected against contamination by moisture or even by small amounts of oil or perspiration which might be left through careless handling. Furthermore, satisfactory spraying cannot be accomplished when the air used has a humidity saturation of 70 per cent or more. When the air is taken from an air-conditioned supply, this is automatically taken care of; but if the air is drawn in from the outside, frequent checks on temperature and humidity are necessary to avoid possible loss through spraying with too damp air, which would result in a poor bond. Aside from these few factors, metal-spraying is a relatively simple operation, and one that has well proved its worth.

The equipment usually required for maintenance work consists of one or more spray guns, a small sand-blasting machine, and necessary auxiliary equipment, including an air compressor and a ventilating fan.

Among the metals frequently used for repair work are: Aluminum alloys, zinc alloys, and stainless-steel alloys. One aluminum alloy that has given good results consists of 0.7 per cent silicon; 1.3 per cent magnesium; 0.25 per cent chromium; and 97.85 per cent aluminum. A suitable zinc alloy consists of 1.00 per cent copper; 0.10 per cent lead; 0.005 per cent cadmium; 0.012 per cent iron; and 98.88 per cent zinc. The stainless-steel alloy may be composed as follows: 0.50 per cent cadmium; 0.45 per cent manganese; 0.040 per cent lead; 0.050 per cent sulphur; 3.00 per cent nickel; 0.75 per cent chromium; and 95.21 per cent iron.

Disston Opens New Armor Plate Plant

Henry Disston & Sons, Inc., Philadelphia, Pa., recently laid the cornerstone of a new $675,000 boiler house, a power addition to the Disston plant that will greatly augment the firm's production of saws and tools. Following this ceremony, the new U. S. A. Philadelphia Armor Plate plant was dedicated. The latter plant was built and equipped by the Quartermaster and Ordnance Departments of the U. S. Army, with the Disston firm acting as consulting engineers. The Disston Company will operate the new armor plate plant on a lease basis. This addition to the company's facilities will practically triple its capacity for fabricating and heat-treating armor plate.

The company shut down the plant at 2:45 P. M. so that its more than 3400 employes could witness both events. William D. Disston, vice-president, acted as chairman of the ceremonies. S. Horace Disston, president, laid the cornerstone of the new boiler house and made the opening address. During his address he made a symbolic award of forty-, thirty- and twenty-year service pins to employes. Richard T. Nalle, vice-president in charge of production, gave a brief talk summarizing the firm's activity in the production of armor plate since the first World War.

Several officers of the United States Army were present at the ceremonies, including Lieutenant Colonel D. N. Hauseman, Executive Officer, Philadelphia Ordnance District, U. S. Army, and Brigadier General C. T. Harris, Jr., Assistant Chief of Ordnance, U. S. Army, both of whom made addresses. The principal speaker of the day was C. Jared Ingersoll, Chief, Philadelphia Ordnance District.

* * *

Westinghouse Self-Contained Air-Conditioning Unit

A new self-contained air-conditioning unit known as the Type SU-20 Unitaire, especially designed for offices, residences, and similar applications, has been developed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This new unit provides year-around air-conditioning through the addition of a steam or hot-water heating coil for winter operation. It can be operated in the room to be air-conditioned or remotely located with connected ducts if desired. The new air-conditioning unit is so completely self-contained that the installation work consists simply of making the necessary water and electrical connections.

NEWS OF THE INDUSTRY

Canada

Philip N. Cooke, sales manager of the Norton Co. of Canada, Ltd., Hamilton, Ontario, has been appointed resident manager, succeeding Robert C. Douglas, who died on May 29. Mr. Cooke has been with the Canadian plant from its beginning, having left Worcester in June, 1920, as one of the original Canadian-Norton organization. For the first few years he held the title of sales engineer, but for more than fifteen years his position has been that of sales manager. D. M. Chisholm, of the Canadian sales organization, succeeds Mr. Cooke as sales manager.

California

W. A. Fletcher has been appointed district sales manager of the western division of E. F. Houghton & Co., Third, American, and Somerset Sts., Philadelphia, Pa., manufacturer of metal-working products, oils, and leathers. His headquarters will be at 835 Harrison St., San Francisco, Calif., and his territory will include California, Oregon, and Washington. Mr. Fletcher was formerly district sales manager of the company in Cleveland, and more recently, head of the Government Products Division.

Illinois and Missouri

M. J. Tennes, Jr., president of the Shafer Bearing Corporation, 35 E. Wacker Drive, Chicago, Ill., manufacturer of radial-thrust roller bearings, has entered active service as captain in the United States Army Air Corps, with permanent station at the Air Corps Advanced Flying School, Phoenix, Ariz. During the absence of Captain Tennes, the management of the corporation will be under the direction of John F. Ditzell, vice-president and general manager. The company is very active in the industrial phase of the National Defense effort, being engaged in supplying large quantities of bearings to aircraft manufacturers.

F. V. MacArthur has resigned as secretary and assistant treasurer of the Link-Belt Co., Chicago, Ill., after nearly fifty years of service. Harry E. Kellogg, treasurer and assistant secretary, has been elected secretary, and will now serve as secretary and treasurer. Melbourne P. Anderson, formerly general accountant, has been made assistant treasurer, and Henry C. Oakes, statistician, becomes assistant secretary.

C. W. Pearsall has been appointed general sales manager of the Ahlberg Bearing Co., Chicago, Ill., manufacturer of CJB ball bearings, pillow blocks, and Ahlberg ground bearings. Mr. Pearsall has been connected with the Ahlberg organization since 1919. He was previously manager of distributor sales.

Herman Nelson Corporation, Moline, Ill., has purchased the entire assets and business of the Autovent Fan and Blower Co., Chicago, Ill., and will conduct the business as the Autovent Fan and Blower Division of the corporation. The Autovent line includes centrifugal blowers and propeller exhaust and ventilating fans.

Lord Mfg. Co., Erie, Pa., manufacturer of bonded rubber mountings, has opened a district office at 4937 Laclede Ave., St. Louis, Mo. George Harrington will be in charge of the office, and will represent the company in southern Illinois, Indiana, Missouri, Kansas, and the Southwest.

Michigan and Wisconsin

Progressive Welder Co., 3050 E. Outer Drive, Detroit, Mich., manufacturer of resistance welding equipment, has expanded its service and sales organization by the establishment of eight branch offices located in the major industrial areas. Six additional offices are provided by independent distributors handling sales and service on the company's line of welding machines and equipment.

Michigan Tool Co., East McNichols Road, Detroit, Mich., announces that to eliminate misunderstandings, the designation of "worm-gearing" in connection with the double-enveloping Cone-Drive type of gearing made by the company is being discontinued. The announcement includes a change in name from the former Cone Worm Gear Division of the company to Cone Drive Division.

Edwin Fisher, who has been manager of the Jefferson Ave., Detroit, branch of the Cadillac Motor Car Co. for the last four years, has joined the Progressive Welder Co., Detroit, Mich., in an executive sales capacity. In his new connection, Mr. Fisher will assist in the development of sales of the company's resistance welding equipment in the middle-western area.

Michigan Tool Co., East McNichols Road, Detroit, Mich., announces that the production of Cone-Drive gearing is now under way in the newest addition to the company's plant. The new building is of one- and two-story combination construction, and will be devoted exclusively to Cone-Drive speed reducer production.

L. Bruce Grannis has been elected vice-president in charge of sales of the Anker-Holth Mfg. Co., Inc., Port Huron, Mich., manufacturer of air chucks and cylinders. Leo T. Neidow has been elected vice-president in charge of engineering and production.

James W. Parker, vice-president in charge of engineering of the Detroit Edison Co., Detroit, Mich., has been nominated for president of the American Society of Mechanical Engineers to serve for the year 1942.

Taylor Mfg. Co., manufacturer of balancing machines, sensitive drilling machines, and drill presses, announces that the company has moved into its new plant, which has just been completed at 3056 W. Meinecke Ave., Milwaukee, Wis.

New England

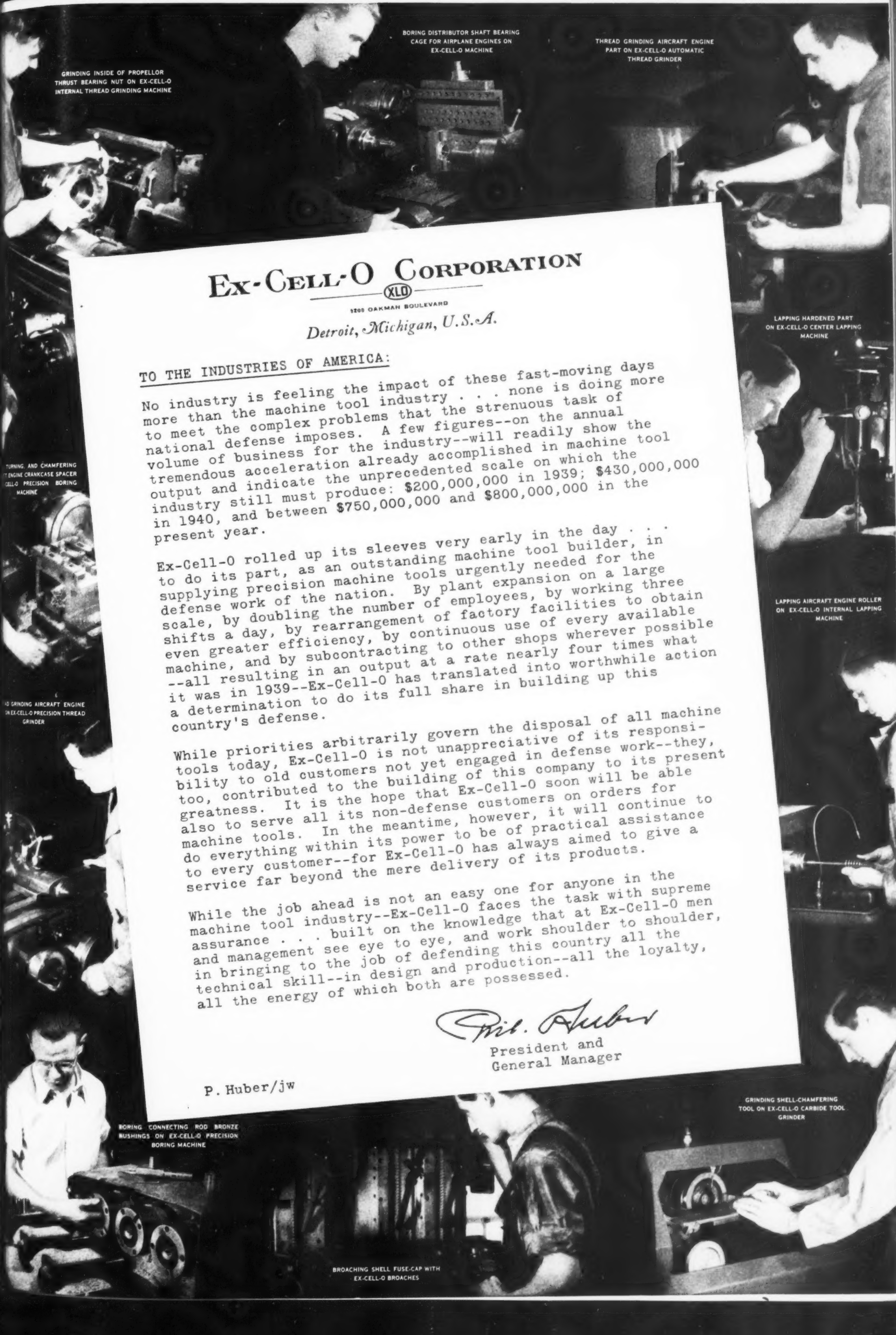
Clover Mfg. Co., Norwalk, Conn., manufacturer of coated abrasives, and lapping and grinding compounds, announces the addition of L. P. O'Neill and L. W. Kilpatrick to its sales force. Mr. O'Neill will cover the Chicago territory, and Mr. Kilpatrick will cover the states of North and South Dakota, Minnesota, and northern Iowa. Gerald R. Barrett has been transferred from the metropolitan New York area to Boston, and will serve the New England territory.

Norton Co., Worcester, Mass., manufacturer of grinding machines, grinding wheels, and other abrasive products, has appointed Paul Fielden director of purchases. Mr. Fielden has been connected with the company for twenty-one years as assistant credit manager and credit manager. John Miller will succeed him as credit manager.

New Jersey

James A. Trail has joined the Hyatt Bearings Division, General Motors Sales Corporation, Harrison, N. J. Mr. Trail has been an associate professor in mechanical engineering at the A. & M. College of Texas for several years. He will cover the southwest territory, making his headquarters at Dallas, Tex. A. J. Swisler, who formerly handled this territory, has been transferred to the western division headquarters in Chicago.

Carleton Reynell has been appointed general manager of purchases and traffic for the Worthington Pump and Ma-



GRINDING INSIDE OF PROPELLOR THRUST BEARING NUT ON EX-CELL-O INTERNAL THREAD GRINDING MACHINE

BORING DISTRIBUTOR SHAFT BEARING CAGE FOR AIRPLANE ENGINES ON EX-CELL-O MACHINE

THREAD GRINDING AIRCRAFT ENGINE PART ON EX-CELL-O AUTOMATIC THREAD GRINDER

LAPPING HARDENED PART ON EX-CELL-O CENTER LAPPING MACHINE

TURNING, AND CHAMFERING ...T ENGINE CRANKCASE SPACER ...CELL-O PRECISION BORING MACHINE

LAPPING AIRCRAFT ENGINE ROLLER ON EX-CELL-O INTERNAL LAPPING MACHINE

...D GRINDING AIRCRAFT ENGINE ...N EX-CELL-O PRECISION THREAD GRINDER

BORING CONNECTING ROD BRONZE BUSHINGS ON EX-CELL-O PRECISION BORING MACHINE

GRINDING SHELL-CHAMFERING TOOL ON EX-CELL-O CARBIDE TOOL GRINDER

BROACHING SHELL FUSE-CAP WITH EX-CELL-O BROACHES

EX-CELL-O CORPORATION

XLO

1200 OAKMAN BOULEVARD

Detroit, Michigan, U.S.A.

TO THE INDUSTRIES OF AMERICA:

No industry is feeling the impact of these fast-moving days more than the machine tool industry . . . none is doing more to meet the complex problems that the strenuous task of national defense imposes. A few figures--on the annual volume of business for the industry--will readily show the tremendous acceleration already accomplished in machine tool output and indicate the unprecedented scale on which the industry still must produce: \$200,000,000 in 1939; \$430,000,000 in 1940, and between \$750,000,000 and \$800,000,000 in the present year.

Ex-Cell-O rolled up its sleeves very early in the day . . . to do its part, as an outstanding machine tool builder, in supplying precision machine tools urgently needed for the defense work of the nation. By plant expansion on a large scale, by doubling the number of employees, by working three shifts a day, by rearrangement of factory facilities to obtain even greater efficiency, by continuous use of every available machine, and by subcontracting to other shops wherever possible --all resulting in an output at a rate nearly four times what it was in 1939--Ex-Cell-O has translated into worthwhile action a determination to do its full share in building up this country's defense.

While priorities arbitrarily govern the disposal of all machine tools today, Ex-Cell-O is not unappreciative of its responsibility to old customers not yet engaged in defense work--they, too, contributed to the building of this company to its present greatness. It is the hope that Ex-Cell-O soon will be able also to serve all its non-defense customers on orders for machine tools. In the meantime, however, it will continue to do everything within its power to be of practical assistance to every customer--for Ex-Cell-O has always aimed to give a service far beyond the mere delivery of its products.

While the job ahead is not an easy one for anyone in the machine tool industry--Ex-Cell-O faces the task with supreme assurance . . . built on the knowledge that at Ex-Cell-O men and management see eye to eye, and work shoulder to shoulder, in bringing to the job of defending this country all the technical skill--in design and production--all the loyalty, all the energy of which both are possessed.

Phil. Huber

President and
General Manager

P. Huber/jw

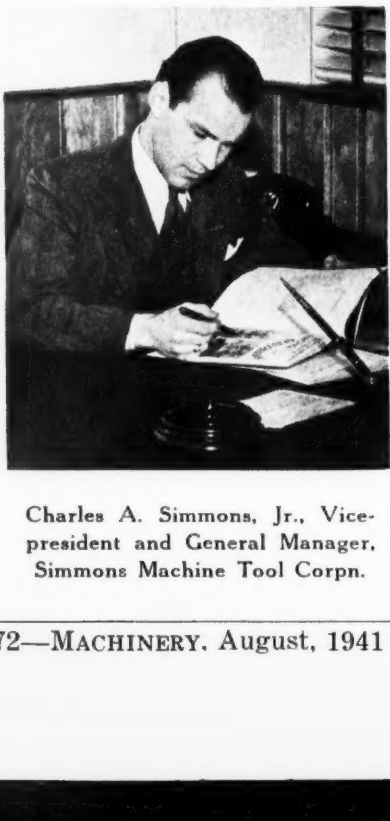
chinery Corporation, Harrison, N. J. FREDERIC W. THOMAS has been made assistant general manager of purchases, and DEAN K. CHADBOURNE assistant general manager of traffic.

New York

GENERAL ELECTRIC CO., Schenectady, N. Y., announces plans for the construction of two new plants for the manufacture of propulsion equipment for merchant ships. The plants will be situated in Erie, Pa., and Lynn, Mass., the Erie plant manufacturing turbines and the Lynn plant reduction gears. They will be financed by the Defense Plant Corporation under a lease agreement. The two plants will add about 475,000 square feet of floor space for defense manufacture, and will employ 2000 persons. With plant expansion already completed or under construction, the new plants will make available a total of 2,675,000 square feet of floor space. This expansion is more than one-third of the former size of the main G-E plant in Schenectady, N. Y. The greatest expansion is taking place in Schenectady itself, where 830,000 square feet of floor space will have been added to the former 6,500,000 square feet.

DR. ARTHUR S. ADAMS has been appointed assistant dean, College of Engineering, Cornell University, Ithaca, N. Y. Dr. Adams went to Cornell a year ago from the Colorado School of Mines. For the past year he has been professor of mechanics, secretary of the Engineering Experiment Station, and director of the Engineering Defense Training Program in Buffalo, Elmira, Binghamton, Geneva, and Ithaca.

CHARLES A. SIMMONS, JR., has been elected vice-president and general manager of the Simmons Machine Tool Corporation, Albany, N. Y. The firm is engaged in the rebuilding field and also in the building of new machine tools for defense work. Charles A. Simmons, Sr., president of the company, is a member of the Tools Section of the OPM, and during his absence in Washington for the last six months, his son has been directing the operation of the Albany plants.



Charles A. Simmons, Jr., Vice-president and General Manager, Simmons Machine Tool Corpn.

WILLIAM H. WINTERROWD, vice-president of the Baldwin Locomotive Works, Eddystone, Pa., CLARKE F. FREEMAN, vice-president of the Manufacturers Mutual Fire Insurance Co., Providence, R. I., CLAIR B. PECK, managing editor of *Railway Mechanical Engineering*, New York City, and WILLIS R. WOOLRICH, dean of engineering and director of the bureau of engineering research, University of Texas, Austin, Tex., have been nominated for vice-presidents of the American Society of Mechanical Engineers to take office at the coming annual meeting in December.

LYON IRON WORKS, Greene, N. Y., manufacturers of hydraulic material-handling machinery, have recently completed the construction of a plant that will increase the production floor space 50 per cent. Additions have been equipped for raw stock storage, steel fabrication, welding, and final assembly. With these improvements and other plant rearrangement, the capacity of the concern has been doubled.

SHERMAN BARNES, in charge of the western New York territory of Ampco Metal, Inc., Milwaukee, Wis., has established new headquarters at 699 Potomac Ave., Buffalo, N. Y.

MAUTE DIE & TOOL WORKS announce the removal of their factory to 861 Jefferson Ave., Buffalo, N. Y.

Ohio

RUTHMAN MACHINERY CO., maker of Gusher coolant pumps, has just moved into a spacious new plant and office at 1819 Reading Road, Cincinnati, Ohio. During the first month the building was occupied, the company increased its output 25 per cent, and it is expected that during the second month the output will reach a 40 per cent increase. The building is a two-story, reinforced-concrete and brick structure, with 15,000 square feet of manufacturing floor space. An adjoining office building has 5000 square feet of floor space. With these new facilities, the company expects to produce about 2000 coolant pumps a month.

J. M. MANLEY, JR., has been appointed personnel director of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. Mr. Manley is widely known in the metal trades field in Cincinnati. He has been secretary of the Industrial Association of Cincinnati, the Cincinnati unit of the National Metal Trades Association, and the Associated Foundries of Cincinnati for ten years.

J. M. Manley, Jr., Personnel Director of the Lodge & Shipley Machine Tool Co.

C. M. MARATTA, who has been maintenance engineer for the Timken Roller Bearing Co., Canton, Ohio, since 1921, has been appointed chief works engineer to fill the vacancy caused by the death of W. C. MAKLEY. WALTER F. GREEN, who has been with the engineering department of the company since 1935, becomes assistant works engineer. PUTNEY L. WRIGHT, who has been connected with the organization since 1938, will be plant engineer.

HOWARD J. TAIT has been appointed works manager of the Newark, Ohio, factory of the Holophane Co., Inc., 342 Madison Ave., New York City, manufacturer of lighting equipment.

J. EARL ROMER has been appointed district manager of the Cleveland office of Bliss & Laughlin, Inc., succeeding A. W. SCHULTZ.

Pennsylvania

DEAN HARVEY, materials engineer of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was elected vice-president of the American Society for Testing Materials at the convention of the Society held on June 24 in Chicago. Mr. Harvey has the degree of electrical engineer, and has been associated with tne Westinghouse organization since 1904 as design engineer and materials engineer. He was formerly chairman of the Pittsburgh district committee of the American Society for Testing Materials.

THOMAS F. TROXELL has been elected treasurer and a director of the Copperweld Steel Co., Glassport, Pa. SIDNEY D. WILLIAMS, formerly vice-president

in charge of steel sales, has been made executive vice-president in charge of the Warren, Ohio, division. WILLIAM B. KLEE, JR., assistant secretary, has been made assistant to the executive vice-president.

C. G. SKIDMORE, specialist on motor control for power plants, has been transferred from the New York office of Cutler-Hammer, Inc., Milwaukee, Wis., to the Philadelphia office of the company.

INDUSTRIAL PRODUCTS Co., manufacturer of safety equipment, announces the removal of the company from 800 W. Somerset St., Philadelphia, Pa., to larger quarters at 2820 N. Fourth St.

JONES & LAUGHLIN STEEL CORPORATION, Pittsburgh, Pa., is building a 120- by 275-foot addition to its wire rope plant at Muncy, Pa. A new office building is also being constructed.

Texas

HARRY MCCOOL, JR., has been appointed south-western sales representative for the Steel and Tube Division of the Timken Roller Bearing Co., Canton, Ohio. His territory will include Kansas, Louisiana, Oklahoma, Arkansas, and Texas, and his headquarters will be in Dallas, Tex. Mr. McCool previously served as superintendent of the Timken tube mill at Wooster, Ohio, but was transferred to the sales department of the Steel and Tube Division about five months ago.

* * *

Electrically Heated Flying Suits for U. S. Army

The first large-scale contract for a newly perfected electrically heated flying suit to keep aviators warm at high altitudes has been awarded to the General Electric Co., Bridgeport, Conn., by the United States Army Air Corps. These electrically heated flying suits are a remarkable achievement. They are designed to keep an aviator comfortable through a 130-degree range of temperature—from 70 degrees F. above zero to 60 degrees below zero. The flying suit is wired throughout, and the amount of heat supplied electrically is controlled so as to be easily adjusted for changes in temperature.

The new equipment is many pounds lighter than the sheepskin-lined garment that it replaces. The new suits give the aviator more freedom of action and ease in manipulating instruments, controls, and armaments. Furthermore, the whole outfit can be supplied at less cost to the Government. The General Electric Co. has been working for many months with Army technicians in developing and improving the new suit.

NEW BOOKS AND PUBLICATIONS

ESSENTIALS OF SHOP MATHEMATICS. By Samuel Slade and Louis Margolis. 194 pages, 5 1/4 by 7 1/2 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $1.50.

This book has been written to provide a basic text in mathematics as applied to the trades most commonly taught in trade and industrial schools and in the trade classes of junior high schools. The first chapter treats on mensuration of surfaces and volumes in great detail, and forms the basis for the chapters that follow. Automobile mechanics, electric wiring, machine shop practice, printing, sheet-metal work, and woodwork are the trades covered, and in each case, the authors have included only the minimum of mathematics required by the intelligent worker in that trade. The book is suitable for short courses covering one school year, and also for more advanced work where the courses are two years or more.

TRAINING WORKERS AND SUPERVISORS. By Charles Reitell. 182 pages, 5 1/2 by 8 inches. Published by the Ronald Press Co., 15 E. 26th St., New York City. Price, $1.50.

This book is intended to aid the executive or foreman in selecting and training workers. The information given is based on experience and problems encountered in actual practice. The book shows what has been accomplished by many companies in successfully meeting their needs for an expanded labor force of high quality and a competent supervising force. Part I discusses principles and methods for selecting new employes, covering such details as job ratings, the use of application forms, tests, and the technique of interviewing. Part II outlines specific methods of training. Part III discusses the role of standards and their specific application to costs, to quality and quantity, and to planned operations. Part IV deals with human relations.

SET-UP AND OPERATION OF BROWN & SHARPE AUTOMATIC SCREW MACHINES. Series of fourteen booklets, 6 by 9 inches. Distributed by the Brown & Sharpe Mfg. Co., Providence, R. I. Price, 50 cents.

These booklets are designed to aid beginners in screw machine operation. They contain general operating descriptions and useful tables for the Nos. 00, 0, and 2 sizes of automatic screw machines. Full instructions for sharpening and adjusting all the commonly used tools are given. Twelve typical screw machine jobs are covered. The company is offering a Teaching Kit with orders of twelve or more sets of booklets, which consists of complete machine and attachment specifications, "Construction and Use of Automatic Screw Machines," a booklet on "Screw Machine Tools," and a general catalogue listing Brown & Sharpe screw machine equipment.

INTRODUCTION TO WORKS PRACTICE. Prepared by a staff of technical experts under the direction of E. Molloy. 104 pages, 5 1/2 by 8 3/4 inches. Published by the Chemical Publishing Co., Inc., 234 King St., Brooklyn, N. Y. Price, $2.

This book has been prepared to serve as a practical guide to procedure in engineering production. It is intended for the young man who desires to fit himself for advancement to positions of greater responsibility in industry. It covers the three fundamentals to progress in engineering work, namely, the ability to read an engineering drawing; knowledge of precision instruments, such as the micrometer and vernier caliper; and an acquaintance with practical mathematics as required for working out the calculations encountered in shop work.

INDUSTRIAL HEALTH PRACTICES. 76 pages, 6 by 8 1/2 inches. Published by the National Association of Manufacturers, 14 W. 49th St., New York City. Price, free to members of the Association; to others, 50 cents per copy.

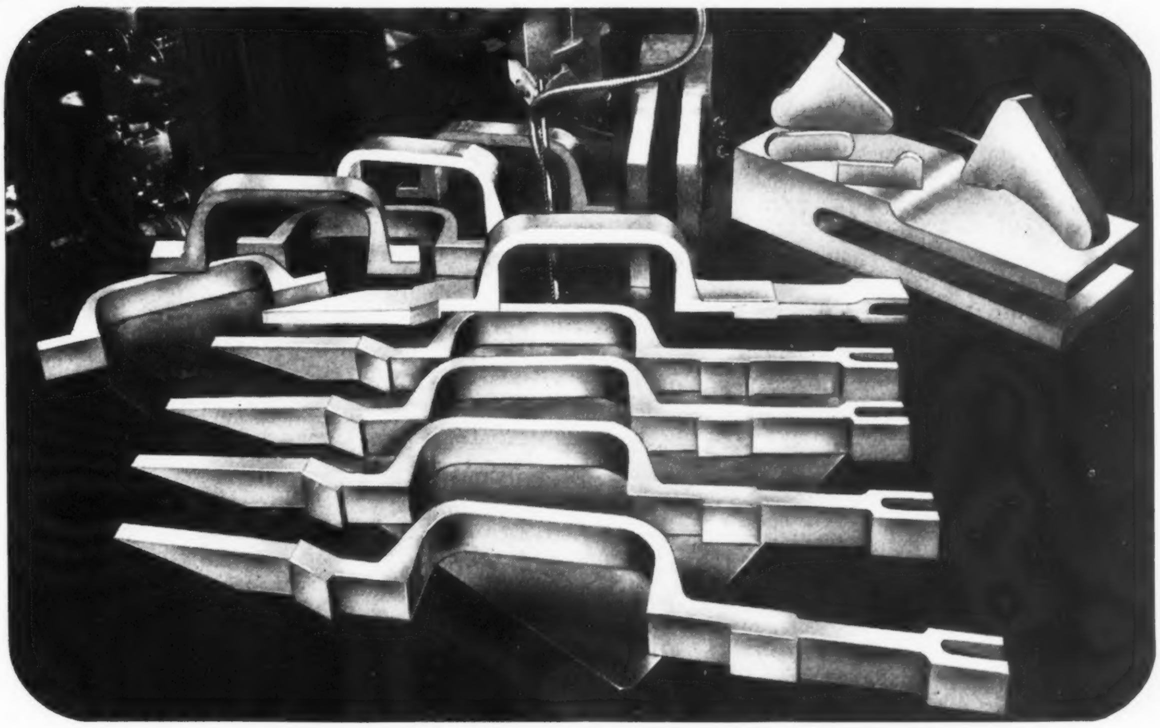
This booklet contains a report of a survey of over 2000 industrial establishments covering health practices in industry. It contains much valuable information regarding the use and cost of health programs, as well as industrial physical examination practices.

AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE HYDRAULIC RAM. By Wallace M. Lansford and Warren G. Dugan. 70 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Engineering Experiment Station Bulletin No. 326. Price, 70 cents.

FATIGUE TESTS OF WELDED JOINTS IN STRUCTURAL STEEL PLATES. 86 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Engineering Experiment Station Bulletin No. 327. Price, $1.

HOW INVENTORS CAN AID NATIONAL DEFENSE. 22 pages, 6 by 9 inches. Published by the United States Department of Commerce, Washington, D. C., as Information Bulletin No. 2.

DoAll SAVED $600 ON THIS ONE JOB!



Taylor-Wilson Mfg. Co., McKees Rocks, Pa., had an important defense contract calling for forgings for large parts in the foreground. Dies would have cost lots of money. Making them by hand would have been slow and very expensive. The DoAll made the parts in 16 hours and this firm calculates that the saving was $600.

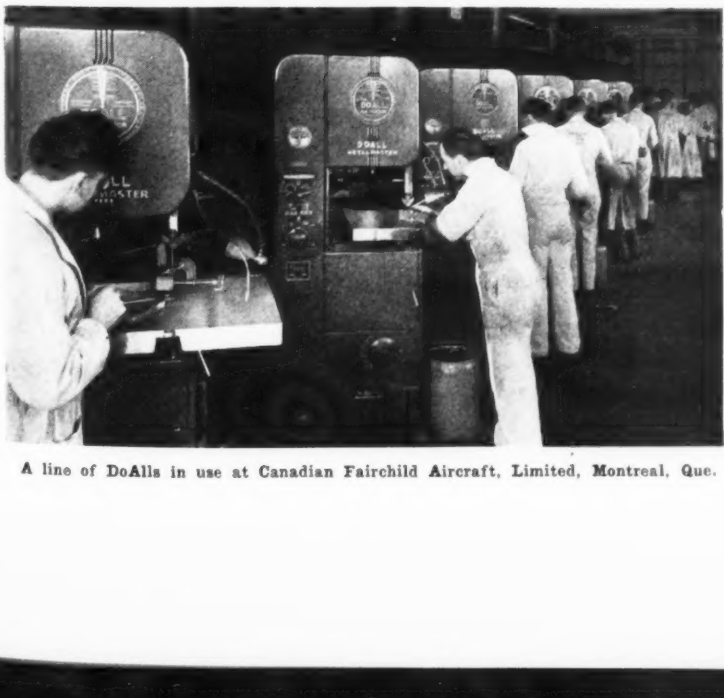
TODAY'S MIGHTY PRODUCTION TOOL

★ **When Precision Cutting is Essential**

★ **When Speed is a Big Factor**

DO-ALL Contour Machine BAND SAWING BAND FILING BAND POLISHING

DoAll is doing First Aid service in large and small plants wherever metal is cut—to make molds, dies and special tools — on the production line in motor and aeroplane factories, arsenals, shipyards, etc. Takes the place of shaper, milling and lathe work.



A line of DoAlls in use at Canadian Fairchild Aircraft, Limited, Montreal, Que.

IMMEDIATE DELIVERY

Every 40 minutes a DoAll comes off our assembly line. We are keeping up with the demand for these indispensable machine tools. All orders are given prompt attention.

Let one of our trained men come to your plant and show you how the DoAll can cut time and costs for you.

FREE—Literature and 158-page Handbook on Contour Machining.

CONTINENTAL MACHINES, INC.

1312 S. Washington Ave., Minneapolis, Minn.

Associated with the DOALL COMPANY, Des Plaines, Ill., Manufacturers of Band Saws and Band Files for DoAll Contour Machines.

COMING EVENTS

September 17-19—Annual conference of the National Industrial Advertisers Association at the Royal York Hotel, Toronto, Canada. For additional information, address National Industrial Advertisers Association, Inc., 100 E. Ohio St., Chicago, Ill.

September 25-26—National Tractor Meeting of the Society of Automotive Engineers at the Schroeder Hotel, Milwaukee, Wis. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

October 6-11—Exposition of Power and Mechanical Engineering at the International Amphitheater, Chicago, Ill. For further information, address Charles F. Roth, manager, Grand Central Palace, New York City.

October 12-15—Fall meeting of the American Society of Mechanical Engineers at Louisville, Ky. C. E. Davies, secretary, 29 W. 39th St., New York City.

October 16-18—Semi-annual meeting of the American Society of Tool Engineers at the Royal York Hotel, Toronto, Canada. Ford R. Lamb, executive secretary, 2567 W. Grand Blvd., Detroit, Mich.

October 20-24—Twenty-third National Metal Congress and Exposition to be held in Convention Hall and Commercial Museum, Philadelphia, Pa. Further information can be obtained from W. H. Eisenman, secretary, American Society for Metals, 7301 Euclid Ave., Cleveland, Ohio.

October 30-November 1—National Aircraft Production Meeting of the Society of Automotive Engineers at the Biltmore Hotel, Los Angeles, Calif. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

December 1-5—Annual meeting of the American Society of Mechanical Engineers at the Hotel Astor, New York City. C. E. Davies, secretary, 29 W. 39th St., New York City.

January 12-16, 1942—Annual meeting of the Society of Automotive Engineers at the Book Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

* * *

Proportion of War Orders in Industry

Orders received by the General Electric Co., Schenectady, N. Y., during the first six months of this year amounted to over $521,000,000, compared with $212,650,000 for the same period last year. Of the orders received during the first half of this year, those definitely known to cover national defense items amounted to $216,000,000. About $466,000,000 worth of national defense orders have been received by the General Electric Co., since the National Defense Program was instituted last year.

OBITUARIES

Warren Gilman Jones, president of the W. A. Jones Foundry & Machine Co., Chicago, Ill., died on June 6 at his home in River Forest, Ill., following a heart attack. Mr. Jones was well known in industrial and engineering circles. He was born in Chicago in 1890, and entered his father's business in 1910, of which he had been president since 1925. Mr. Jones is survived by his widow and three children, a daughter and two sons.

John W. Savage, assistant to the president of the General Electric Co., and for more than twenty years closely associated with the company's distribution and commercial research problems, died on July 9 at the Harkness Pavilion of the Rockefeller Medical Center, following a few months' illness. Complications resulting from an operation were the immediate cause of his death. He was forty-nine years old.

* * *

Machines for Producing Continuous Hinges Wanted

A metal products manufacturer would like to be placed in contact with the manufacturers of special machinery to produce "continuous hinges." Any machinery manufacturer interested is requested to communicate with Editor, Machinery, 148 Lafayette St., New York.

Allan Lampi (Left) 2400th Man to Graduate from General Electric's Apprentice Course for Machinists and Toolmakers, being Congratulated by B. G. Tang, General Superintendent of the Company's Schenectady Plant. Mr. Lampi Became an Apprentice in 1937, after Graduating from High School. He Completed the G-E Course on June 18, and is Now a Machinist in the Company's Turbine Department at Schenectady

MACHINERY'S DATA SHEETS 425 and 426

CUTTING FLUIDS FOR MACHINING OPERATIONS*—3

In Data Sheets Nos. 426 and 427 (the latter to be published in October MACHINERY), cutting fluids are recommended for different cutting processes or operations arranged in order of severity (beginning with the most severe), and for each of the six classes of metals, the machinability rating of which is given in Data Sheet No. 424 (published in August MACHINERY). The severity rate indicates, for example, that internal broaching, generally speaking, is the most severe machining operation as regards cutting fluids, while grinding, on the whole, is the least severe.

It will be noted that in most cases two or more cutting fluids are listed as satisfactory. When a particular fluid is preferred for a given operation and material, it is designated in Italic type.

The Committee of the Society of Automotive Engineers that compiled these recommendations reported as follows:

The recommendations are intended to serve only as a guide in deciding upon cutting speeds and in the choice of cutting fluids. Hard and fast rules are not possible, since a cutting fluid must be selected with reference not only to the individual operation and material, but also to the conditions under which the operation is performed, such as speed, depth of cut, feed, desired tool life, tool material, and desired finish.

The Committee also makes these observations:

Sulphurized oils have a tendency to stain certain non-ferrous metals, such as copper and its alloys.

In the machining of aluminum, cutting oils and emulsions are sometimes diluted with kerosene with satisfactory results.

Magnesium and its alloys usually are machined dry, powdered asbestos being available to smother flames if started. Emulsions or water should not be used. If a cutting fluid is used, a mineral-seal oil mixture is recommended.

Generally speaking, mineral-lard and sulphurized oil mixtures of low sulphur percentages can be used interchangeably.

For best tool life, cutting fluids should be applied in large quantities at high velocities and at low temperatures.

It is possible to select the proper cutting fluid for normal operating conditions by referring to Data Sheets Nos. 426 and 427, which are based upon normal operating speeds, tool life, and finish. However, if a deeper cut, higher cutting speed, heavier feed, etc., are desired, it will be necessary for the user to be guided by the tables in placing the operation in the proper severity classification, and using the cutting oils that are recommended for the more severe operation.

The cutting fluid recommendations must, of necessity, be confined to types of fluids rather than individual products. This should be remembered in the purchase of these fluids. There may be quite a difference in effectiveness between two fluids of the same type on a given machining operation, owing to the fact that different manufacturing methods may be used in producing cutting fluids of the same classification.

*Based on a Report of the Sub-Committee on Cutting Fluids of the Society of Automotive Engineers, Presented by H. L. Moir and O. W. Boston before the Production Meeting of the Society at Hartford, Conn., May 7, 1940

MACHINERY'S Data Sheet No. 425, September, 1940

CUTTING FLUIDS FOR MACHINING OPERATIONS—4

Severity of Operation	Type of Operation	Machinability Class (See Data Sheet No. 424, August, 1940) 1	2	3	4	5	6
		Kind of Cutting Lubricant					
1	Broaching, Internal	Em. Sulf.	*Sulf.* Em.	*Sulf.* Em.	*Sulf.* Em.	MO Em.	Sulf. ML
2	Broaching, Surface	Em. Sulf.	*Em.* Sulf.	*Sulf.* Em.	*Sulf.* Em.	MO Em.	Sulf. ML
2	Tapping, Plain	Sulf.	Sulf.	Sulf.	Sulf.	Em. Dry	Sulf. ML
2	Threading, Pipe	Sulf.	*Sulf.* ML	Sulf.	Sulf.	...	Sulf.
3	Threading, Plain	Sulf.	Sulf.	Sulf.	Sulf.	Em. Sulf.	Sulf.
4	Gear Shaving	Sulf. L	Sulf. L	Sulf. L	Sulf. L	...	...
4	Reaming, Plain	ML Sulf.	ML Sulf.	ML Sulf.	ML Sulf.	ML MO Em.	ML MO Sulf.
4	Gear Cutting (See note)	Sulf. ML Em.	Sulf.	Sulf.	Sulf. ML	...	Sulf. ML
5	Drilling, Deep	*Em.* ML	Sulf. *Em.*	Sulf.	Sulf.	MO ML Em.	Sulf. ML
6	Milling, Plain	*Em.* ML Sulf.	Em.	Em.	Sulf.	Em. MO Dry	Sulf. Em.
6	Milling, Multiple Cutter	ML	Sulf.	Sulf.	*Sulf.* ML	Em. MO Dry	*Sulf.* Em.

Symbols for Cutting Fluids

K = Kerosene
L = Lard Oil
MO = Mineral Oils
ML = Mineral-Lard Oil Mixtures
Sulf. = Sulfurized Oils
Em. = Soluble or Emulsifiable Oils and Compounds
Dry = No Cutting Fluid

When two or more cutting fluids are suggested for the same operation the cutting fluid printed in Italic type is the preferred one.

In threading copper, palm oil is frequently used.

It has been reported by several observers that emulsions are usually unsatisfactory on some precision machine tools, such as Fellows and Gleason gear generators.

MACHINERY'S Data Sheet No. 426, September, 1940

To be continued in Data Sheet No. 427

MACHINERY'S DATA SHEETS 427 and 428

CUTTING FLUIDS FOR MACHINING OPERATIONS*—5

Severity of Operation	Type of Operation	Machinability Class (See Data Sheet No. 424, August, 1940)					
		1	2	3	4	5	6
		Kind of Cutting Lubricant					
7	Boring, Multiple-head	*Sulf.* Em.	*Sulf.* Em.	*Sulf.* Em.	Sulf. Em.	K Em. Dry	Sulf. Em.
7	Automatic Screw Machine—Drilling, Forming, Tapping, Turning, Threading, Reaming, Box-Milling, Cutting Off	Sulf. ML Em.	Sulf. ML Em.	Sulf. ML Em.	Sulf. ML Em.	Em. ML Dry	Sulf.
8	Turret Lathe—Drilling, Forming, Tapping, Turning, Threading, Reaming, Box-Milling, Cutting Off	Sulf. ML Em.	Sulf. ML Em.	Sulf. ML Em.	Sulf. ML Em.	Em. ML Dry	Sulf.
9	Drilling	Em.	Em.	Em.	Em.	Em. Dry	Em.
9	Planing, Shaping	Em. ML Sulf.	*Em.* ML Sulf.	Sulf. *Em.*	*Em.* Sulf.	Em.	Em.
9	Turning, Single-point Form Tools	Em. ML Sulf.	Em. ML Sulf.	Em. ML Sulf.	Em. ML Sulf.	Em. ML Dry	Em.
10	Sawing, Circular, Hack.......	Sulf. ML Em.	Sulf. ML Em.	Sulf. ML Em.	Sulf. ML Em.	Dry Em. MO	Sulf. ML Em.
10	Grinding	Em. Sulf.	Em. Sulf.	Em. Sulf.	Em. Sulf.	Em. MO	Em. Sulf.

Symbols for Cutting Fluids

K = Kerosene
L = Lard Oil
MO = Mineral Oils
ML = Mineral-Lard Oil Mixtures
Sulf. = Sulfurized Oils
Em. = Soluble or Emulsifiable Oils and Compounds
Dry = No Cutting Fluid

When two or more cutting fluids are suggested for the same operation, the cutting fluid abbreviation printed in *Italic* type indicates the preferred fluid for the operation.

In threading copper, palm oil is frequently used.

*Based on a Report of the Sub-Committee on Cutting Fluids of the Society of Automotive Engineers, Presented by H. L. Moir and O. W. Boston before the Production Meeting of the Society at Hartford, Conn., May 7, 1940.

MACHINERY'S Data Sheet No. 427, October, 1940

TAP DRILL SIZES FOR VARYING PERCENTAGES OF FULL THREAD—1

Tap		Tap Drill Size				Per Cent of Full Thread	Screw Thread Commission Minor Diameter Limits for Nut	
Size, No.	Threads per Inch	Drill No.	Inch	Millimeters	Decimals of Inch		Min.	Max.
0	80			1.30	0.0512	54	0.0465	0.0492
				1.25	0.0492	68		
				1.20	0.0472	79		
			3/64		0.0469	81		
1	64		1/16		0.0625	51	0.0561	0.0604
				1.55	0.0610	59		
		53			0.0595	66		
				1.50	0.0590	69		
				1.45	0.0571	77		
		54			0.0550	88		
1	72	52			0.0635	53	0.0580	0.0610
			1/16		0.0625	58		
				1.55	0.0610	66		
		53			0.0595	75		
				1.50	0.0590	77		
2	56	49			0.0730	56	0.0667	0.0715
				1.80	0.0709	65		
		50			0.0700	69		
				1.75	0.0689	74		
		51			0.0670	82		
2	64			1.90	0.0748	55	0.0691	0.0724
		49			0.0730	64		
				1.85	0.0728	65		
				1.80	0.0709	74		
		50			0.0700	79		
				1.75	0.0689	84		
3	48			2.15	0.0846	53	0.0764	0.0820
				2.10	0.0827	60		
		45			0.0820	63		
		46			0.0810	66		
		47			0.0785	76		
				1.95	0.0768	82		
		48			0.0760	85		
3	56			2.20	0.0866	53	0.0797	0.0834
		44			0.0860	56		
				2.15	0.0846	62		
				2.10	0.0827	70		
		45			0.0820	73		
		46			0.0810	77		
				2.05	0.0807	79		
4	36	43			0.0890	64	0.0821	0.0882
		44			0.0860	72		
		45			0.0820	83		
4	40			2.40	0.0945	54	0.0849	0.0913
		42			0.0935	57		
				2.35	0.0925	60		
				2.30	0.0905	66		
		43			0.0890	71		
				2.20	0.0866	78		
		44			0.0860	80		

MACHINERY'S Data Sheet No. 428, October, 1940

Compiled by R. G. Haskins Co.
Chicago, Ill.

MACHINERY'S DATA SHEETS 429 and 430

TAP DRILL SIZES FOR VARYING PERCENTAGES OF FULL THREAD—2

Tap		Tap Drill Size				Per Cent of Full Thread	Screw Thread Commission Minor Diameter Limits for Nut	
Size, No.	Threads per Inch	Drill No.	Inch	Milli-meters	Decimals of Inch		Min.	Max.
4	48			2.45	0.0964	57	0.0894	0.0937
		41			0.0960	59		
				2.40	0.0945	64		
		42			0.0935	68		
				2.35	0.0925	72		
				2.30	0.0905	79		
		43			0.0890	85		
5	40			2.70	0.1063	57	0.0979	0.1043
		37			0.1040	65		
				2.60	0.1024	70		
		38			0.1015	72		
		39			0.0995	78		
		40			0.0980	83		
5	44			2.75	0.1083	57	0.1004	0.1049
		36			0.1065	62		
		37			0.1040	71		
				2.60	0.1024	76		
		38			0.1015	79		
		39			0.0995	86		
6	32	33			0.1130	62	0.1042	0.1118
		34			0.1110	66		
				2.80	0.1102	68		
		35			0.1100	69		
				2.75	0.1083	73		
		36			0.1065	77		
		37			0.1040	83		
6	40	31			0.1200	55	0.1109	0.1158
				3.00	0.1181	61		
		32			0.1160	68		
				2.90	0.1142	73		
		33			0.1130	77		
		34			0.1110	83		
8	32		9/64		0.1406	57	0.1302	0.1378
		28			0.1405	58		
				3.50	0.1378	64		
		29			0.1360	69		
				3.40	0.1338	74		
				3.30	0.1299	84		
8	36	27			0.1440	55	0.1339	0.1391
				3.60	0.1417	61		
		28			0.1405	65		
				3.50	0.1378	72		
		20			0.1360	77		
				3.40	0.1338	83		
10	24	21			0.1590	57	0.1449	0.1541
		22			0.1570	61		
		23			0.1540	66		
		24			0.1520	70		
		25			0.1495	75		
		26			0.1470	79		
		27			0.1440	85		

MACHINERY'S Data Sheet No. 429, November, 1940

Compiled by R. G. Haskins Co.
Chicago, Ill.

TAP DRILL SIZES FOR VARYING PERCENTAGES OF FULL THREAD—3

Tap		Tap Drill Size				Per Cent of Full Thread	Screw Thread Commission Minor Diameter Limits for Nut	
Size, No. or Inch	Threads per Inch	Drill No. or Letter	Inch	Milli-meters	Decimals of Inch		Min.	Max.
10	32	19			0.1660	59	0.1562	0.1618
				4.1	0.1614	70		
		20			0.1610	71		
		21			0.1590	76		
				4.0	0.1574	80		
		22			0.1570	81		
			5/32		0.1562	83		
12	24	14			0.1820	63	0.1709	0.1801
		15			0.1800	66		
		16			0.1770	72		
		17			0.1730	79		
			11/64		0.1719	81		
12	28	12			0.1890	61	0.1773	0.1833
			3/16		0.1875	67		
		14			0.1820	73		
		15			0.1800	77		
		16			0.1770	84		
14	20	7			0.2010	64	0.1889	0.1699
		8			0.1990	68		
		9			0.1960	71		
		10			0.1935	75		
		11			0.1910	78		
1/4	20	4			0.2090	63	0.1959	0.2060
		5			0.2055	67		
		6			0.2040	71		
		7			0.2010	75		
		8			0.1990	78		
1/4	24			5.5	0.2165	62	0.2049	0.2141
		3			0.2130	68		
		4			0.2090	76		
		5			0.2055	82		
1/4	27	2			0.2210	61	0.212	0.218
			7/32		0.2187	65		
		3			0.2130	77		
		4			0.2090	85		
1/4	28	2			0.2210	62	0.2113	0.2173
			7/32		0.2187	67		
				5.5	0.2165	72		
		3			0.2130	80		
1/4	32			5.7	0.2244	63	0.2162	0.2208
		2			0.2210	71		
			7/32		0.2187	77		
				5.5	0.2165	82		
5/16	18	H			0.2660	64	0.2524	0.2630
			17/64		0.2656	65		
		G			0.2610	71		
		F			0.2570	77		
				6.5	0.2520	84		

MACHINERY'S Data Sheet No. 430, November, 1940

Compiled by R. G. Haskins Co.
Chicago, Ill.

MACHINERY'S DATA SHEETS 431 and 432

TAP DRILL SIZES FOR VARYING PERCENTAGES OF FULL THREAD—4

Tap Size, Inch	Tap Threads per Inch	Tap Drill Size: Drill, Letter Size	Tap Drill Size: Inch	Tap Drill Size: Milli-meters	Tap Drill Size: Decimals of Inch	Per Cent of Full Thread	Screw Thread Commission Minor Diameter Limits for Nut: Min.	Screw Thread Commission Minor Diameter Limits for Nut: Max.
5/16	24	J	....	....	0.2770	66	0.2674	0.2739
			....	7.0	0.2756	68		
		I	....	....	0.2720	75		
			....	6.8	0.2677	83		
		H	....	....	0.2660	85		
5/16	27	..	9/32	....	0.2812	65	0.2718	0.2792
		J	....	....	0.2770	74		
		I	....	....	0.2720	84		
5/16	32	..	....	7.3	0.2841	62	0.2787	0.2833
			....	7.2	0.2835	71		
			9/32	....	0.2812	77		
			....	7.1	0.2796	81		
3/8	16	P	....	....	0.3230	64	0.3073	0.3184
			....	8.1	0.3189	69		
		O	....	....	0.3160	72		
			5/16	....	0.3120	77		
			....	7.8	0.3071	83		
3/8	24	R	....	....	0.3390	67	0.3299	0.3364
			....	8.5	0.3345	74		
		Q	....	....	0.3320	79		
			....	8.4	0.3307	82		
			21/64	....	0.3281	86		
3/8	27	..	11/32	....	0.3437	65	0.3347	0.3416
		R	....	....	0.3390	75		
			....	8.5	0.3346	83		
		Q	....	....	0.3320	89		
7/16	14	....	....	9.7	0.3818	60	0.3602	0.3721
		V	....	....	0.3770	65		
			3/8	....	0.3750	67		
		U	....	....	0.3680	75		
			....	9.2	0.3622	81		
			23/64	....	0.3594	84		
7/16	20	X	....	....	0.3970	62	0.3834	0.3906
			....	10.0	0.3937	67		
			25/64	....	0.3906	72		
		W	....	....	0.3860	79		
			....	9.7	0.3818	85		
7/16	24	Y	....	....	0.4040	62	0.3924	0.3985
		X	....	....	0.3970	74		
			....	10.0	0.3937	81		
			25/64	....	0.3906	86		
7/16	27	..	13/32	....	0.4062	65	0.3982	0.4043
		Y	....	....	0.4040	70		
		X	....	....	0.3970	84		
1/2	13	..	7/16	....	0.4375	62	0.4167	0.4290
			....	11.0	0.4331	68		
			27/64	....	0.4219	78		
		Z	....	....	0.4130	87		
1/2	20	..	29/64	....	0.4531	72	0.4459	0.4531
		*	....	....	0.4492	78		

*Special drill required for this size, as the next larger drill gives too great a percentage of thread.

MACHINERY'S Data Sheet No. 431, December, 1940

Compiled by R. G. Haskins Co.
Chicago, Ill.

TAP DRILL SIZES FOR VARYING PERCENTAGES OF FULL THREAD—5

Tap Size, Inch	Tap Threads per Inch	Tap Drill Size: See Note*	Tap Drill Size: Inch	Tap Drill Size: Milli-meters	Tap Drill Size: Decimals of Inch	Per Cent of Full Thread	Screw Thread Commission Minor Diameter Limits for Nut: Min.	Screw Thread Commission Minor Diameter Limits for Nut: Max.
1/2	27	..	15/32	....	0.4687	65	0.4618	0.4672
		*	.....	....	0.4640	75		
		*	.....	....	0.4626	80		
9/16	12	..	1/2	....	0.5000	58	0.4723	0.4850
				12.5	0.4921	65		
			31/64	....	0.4844	72		
				12.0	0.4724	83		
			15/32	....	0.4687	86		
9/16	18	..	33/64	....	0.5156	65	0.5024	0.5100
				13.0	0.5118	70		
			1/2	....	0.5000	86		
9/16	27	..	17/32	....	0.5312	65	0.5234	0.5273
		*	.....	....	0.5265	75		
		*	.....	....	0.5230	82		
5/8	11	..	.....	14.0	0.5512	63	0.5266	0.5397
			35/64	....	0.5469	66		
			17/32	....	0.5312	79		
5/8	18	..	37/64	....	0.5781	65	0.5649	0.5725
				14.5	0.5709	75		
			9/16	....	0.5625	87		
5/8	27	..	19/32	....	0.5937	65	0.5860	0.5912
		*	.....	....	0.5890	75		
		*	.....	....	0.5860	83		
3/4	10	..	.....	17.0	0.6693	62	0.6417	0.6553
			21/32	....	0.6562	72		
				16.5	0.6496	77		
			41/64	....	0.6406	84		
3/4	16	..	45/64	....	0.7031	58	0.6823	0.6903
				17.5	0.6890	75		
			11/16	....	0.6875	77		
			43/64	....	0.6719	92		
3/4	27	..	23/32	....	0.7187	65	0.7102	0.7164
		*	.....	....	0.7140	75		
				18.0	0.7086	86		
7/8	9	..	25/32	....	0.7812	65	0.7547	0.7689
			49/64	....	0.7656	76		
			3/4	....	0.7500	87		
7/8	14	..	13/16	....	0.8125	67	0.7977	0.8062
				20.5	0.8071	73		
			51/64	....	0.7969	84		
7/8	18	..	53/64	....	0.8281	65	0.8149	0.8223
		*	.....	....	0.8210	75		
			13/16	....	0.8125	87		
7/8	27	..	27/32	....	0.8437	65	0.8340	0.8406
		*	.....	....	0.8390	75		
		*	.....	....	0.8340	83		
			53/64	....	0.8281	98		

*Special drill required for tapping, as the next larger drill gives too great a percentage of thread.

MACHINERY'S Data Sheet No. 432, December, 1940

Compiled by R. G. Haskins Co.
Chicago, Ill.

MACHINERY'S DATA SHEETS 433 and 434

MACHINERY'S DATA SHEET INDEX—1

February, 1937, to December, 1940, Inclusive

MACHINERY'S Data Sheet No. 433, January, 1941

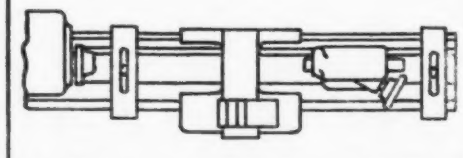
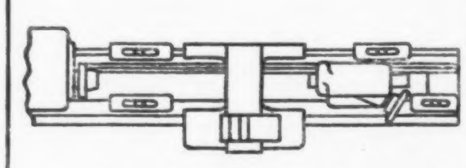
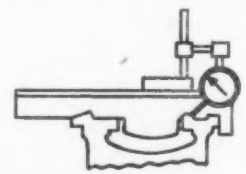
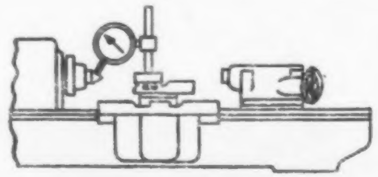
MACHINERY'S DATA SHEET INDEX—2

February, 1937, to December, 1940, Inclusive

MACHINERY'S Data Sheet No. 434, January, 1941

MACHINERY'S DATA SHEETS 435 and 436

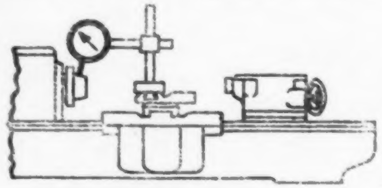
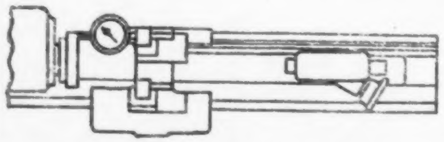
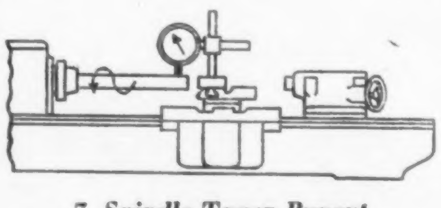
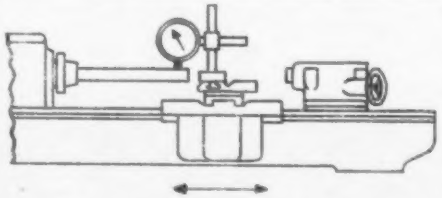
STANDARDS OF ACCURACY FOR ENGINE LATHES—1

Test	Recommended Standards		
	Tool-Room Lathes	12-inch to 18-inch, incl., Engine Lathes	20-inch to 36-inch, incl., Engine Lathes
 1. *Bed Level, Transverse Direction*	When using precision level, both readings to be within 0.0005 inch in 12 inches	When using precision level, both readings to be within 0.0005 inch in 12 inches	When using precision level, both readings to be within 0.001 inch in 12 inches
 2. *Bed Level, Longitudinal Direction*	When using precision level along bed, maximum reading to be within 0.0005 inch in 12 inches	When using precision level along bed, maximum reading to be within 0.0005 inch in 12 inches	When using precision level along bed, maximum reading to be within 0.001 inch in 12 inches
 3. *Tailstock-Way Alignment*	Maximum reading along length of bed 0.0005 inch in 48 inches	Maximum reading along length of bed 0.00075 inch in 48 inches	Maximum reading along length of bed 0.001 inch in 48 inches
 4. *Spindle-Center Runout*	Total indicator reading 0 to 0.0004 inch	Total indicator reading 0 to 0.0005 inch	Total indicator reading 0 to 0.00075 inch

MACHINERY'S Data Sheet No. 435, February, 1941

Adopted by the Lathe Group of the National Machine Tool Builders' Assn.

STANDARDS OF ACCURACY FOR ENGINE LATHES—2

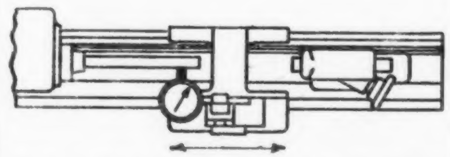
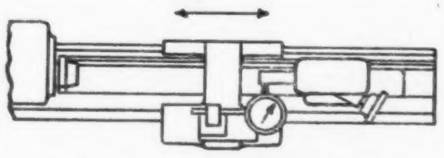
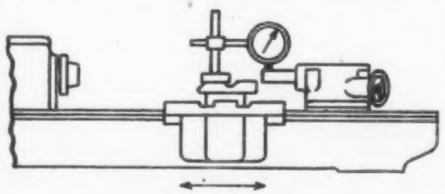
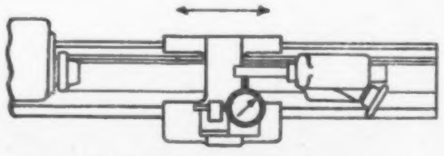
Test	Recommended Standards		
	Tool-Room Lathes	12-inch to 18-inch, incl., Engine Lathes	20-inch to 36-inch, incl., Engine Lathes
 5. *Spindle-Nose Runout*	Total indicator reading, 0 to 0.0003 inch	Total indicator reading, 0 to 0.0004 inch	Total indicator reading, 0 to 0.0006 inch
 6. *Cam Action of Spindle*	Total indicator reading with indicator on rear side of test plate, 0 to 0.0003 inch	Total indicator reading with indicator on rear side of test plate, 0 to 0.0005 inch	Total indicator reading with indicator on rear side of test plate, 0 to 0.00075 inch
 7. *Spindle-Taper Runout*	Total indicator reading at end of 12-inch test bar, 0 to 0.0006 inch. At end of spindle nose, 0 to 0.0003 inch	Total indicator reading at end of 12-inch test bar, 0 to 0.0008 inch. At end of spindle nose, 0 to 0.0004 inch	Total indicator reading at end of 12-inch test bar, 0 to 0.00125 inch. At end of spindle nose, 0 to 0.0006 inch
 8. *Headstock Alignment, Vertical*	High at end of 12-inch test bar, 0 to 0.0005 inch	High at end of 12-inch test bar, 0 to 0.001 inch	High at end of 12-inch test bar, 0 to 0.001 inch

MACHINERY'S Data Sheet No. 436, February, 1941

Adopted by the Lathe Group of the National Machine Tool Builders' Assn.

MACHINERY'S DATA SHEETS 437 and 438

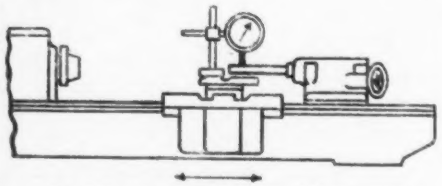
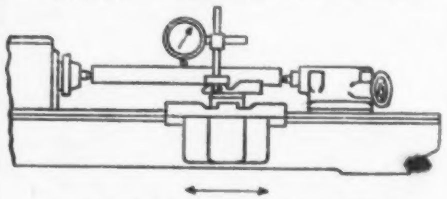
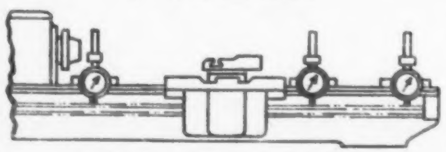
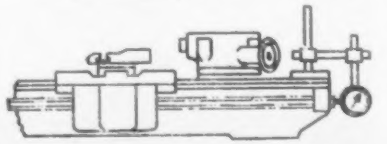
STANDARDS OF ACCURACY FOR ENGINE LATHES—3

Test	Recommended Standards: Tool-Room Lathes	Recommended Standards: 12-inch to 18-inch, incl., Engine Lathes	Recommended Standards: 20-inch to 36-inch, incl., Engine Lathes
 9. *Headstock Alignment, Horizontal*	At end of 12-inch test bar, 0 to ± 0.0003 inch	At end of 12-inch test bar, 0 to ± 0.0005 inch	At end of 12-inch test bar, 0 to ± 0.0008 inch
 10. *Tailstock-Spindle Alignment, Horizontal*	Forward at end of spindle when fully extended, 0 to 0.0005 inch	Forward at end of spindle when fully extended, 0 to 0.0005 inch	Forward at end of spindle when fully extended, 0 to 0.0005 inch
 11. *Tailstock-Spindle Alignment, Vertical*	High at end of spindle when fully extended, 0 to 0.0005 inch	High at end of spindle when fully extended, 0 to 0.0008 inch	High at end of spindle when fully extended, 0 to 0.0015 inch
 12. *Tailstock-Taper Alignment, Horizontal*	End of 12-inch test bar, 0 to ± 0.0005 inch	End of 12-inch test bar, 0 to ± 0.0008 inch	End of 12-inch test bar, 0 to ± 0.0015 inch

MACHINERY'S Data Sheet No. 437, March, 1941

Adopted by the Lathe Group of the National Machine Tool Builders' Assn.

STANDARDS OF ACCURACY FOR ENGINE LATHES—4

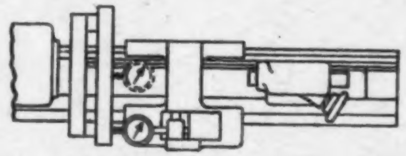
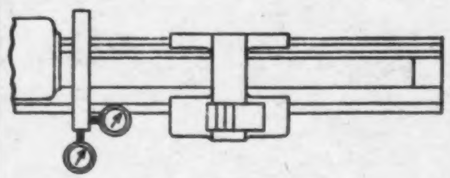
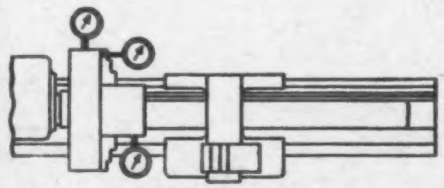
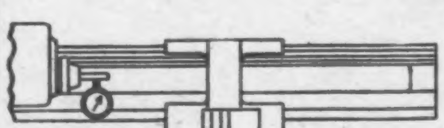
Test	Recommended Standards: Tool-Room Lathes	Recommended Standards: 12-inch to 18-inch, incl., Engine Lathes	Recommended Standards: 20-inch to 36-inch, incl., Engine Lathes
 13. *Tailstock-Taper Alignment, Vertical*	High at end of 12-inch test bar, 0 to 0.0005 inch	High at end of 12-inch test bar, 0 to 0.0008 inch	High at end of 12-inch test bar, 0 to 0.0015 inch
 14. *Vertical Alignment of Head and Tail Centers*	High at tailstock, 0 to 0.0008 inch	High at tailstock, 0 to 0.001 inch	High at tailstock, 0 to 0.0015 inch
Readings for base length bed taken with lead-screw stationary. Add 0.001 inch for each additional 4 feet of bed length.  15. *Lead-Screw Alignment*	Parallel with ways 0 to 0.004 inch horizontal, 0 to 0.004 inch vertical. Alignment of half-nut horizontal or vertical, 0 to 0.006 inch	Parallel with ways 0 to 0.004 inch horizontal, 0 to 0.004 inch vertical. Alignment of half-nut horizontal or vertical, 0 to 0.006 inch	Parallel with ways 0 to 0.006 inch horizontal, 0 to 0.006 inch vertical. Alignment of half-nut horizontal or vertical, 0 to 0.008 inch
 16. *Lead-Screw Cam Action*	Maximum, 0.0003 inch	Maximum, 0.0004 inch	Maximum, 0.0005 inch

MACHINERY'S Data Sheet No. 438, March, 1941

Adopted by the Lathe Group of the National Machine Tool Builders' Assn.

MACHINERY'S DATA SHEETS 439 and 440

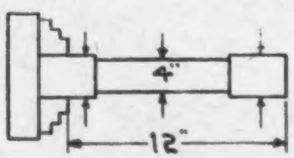
STANDARDS OF ACCURACY FOR ENGINE LATHES—5

Test	Recommended Standards		
	Tool-Room Lathes	12-inch to 18-inch, incl., Engine Lathes	20-inch to 36-inch, incl., Engine Lathes
 17. *Cross-Slide Alignment*	To face hollow or concave only on 12-inch diameter, 0 to 0.0005 inch	To face hollow or concave only on 12-inch diameter, 0 to 0.001 inch	To face hollow or concave only on 12-inch diameter, 0 to 0.001 inch
 18. *Faceplate Runout*	On diameter, 0 to 0.0005 inch. On face at nominal diameter, 0 to 0.001 inch	On diameter, 0 to 0.001 inch. On face at nominal diameter, 0 to 0.0015 inch	On diameter, 0 to 0.0015 inch. On face at nominal diameter, 0 to 0.002 inch
 19. *Chuck Runout*	Face and periphery, 0.003 inch. Face of steps, 0.003 inch. Bar test 3 inches from end of jaw. Bar diameter same as hole, 0.003 inch	Face and periphery, 0.003 inch. Face of steps, 0.003 inch. Bar test 3 inches from end of jaw. Bar diameter same as hole, 0.003 inch	Face and periphery, 0.004 inch. Face of steps, 0.004 inch. Bar test 3 inches from end of jaw. Bar diameter same as hole, 0.004 inch
 20. *Collet Chuck Runout*	One inch from spindle, 0 to 0.001 inch	One inch from spindle, 0 to 0.001 inch	One inch from spindle, 0 to 0.001 inch

MACHINERY'S Data Sheet No. 439, April, 1941

Adopted by the Lathe Group of the National Machine Tool Builders' Assn.

STANDARDS OF ACCURACY FOR ENGINE LATHES—6

Test	Recommended Standards		
	Tool-Room Lathes	12-inch to 18-inch, incl., Engine Lathes	20-inch to 36-inch, incl., Engine Lathes
 21. *Lathe Must Turn Round with Work Mounted in Chuck*	0.0003 inch	0.0004 inch	0.0008 inch
 22. *Lathe Must Turn Cylindrical with Work Mounted in Chuck*	0.0008 inch	0.0015 inch	0.002 inch
 23. *Lathe Must Turn Cylindrical with Work Mounted Between Centers*	0.0004 inch	0.0008 inch	0.001 inch
24. *Lead-Screw* *Lead per Foot* *Lead in Any 4 Inches*	 ± 0.001 inch ± 0.0004 inch	 ± 0.0015 inch ± 0.0005 inch	 ± 0.002 inch ± 0.0007 inch
25. *Backlash* *On Cross-Feed Screw* *On Compound-Rest Screw*	 0.004 inch 0.004 inch	 0.004 inch 0.004 inch	 0.005 inch 0.005 inch

MACHINERY'S Data Sheet No. 440, April, 1941

Adopted by the Lathe Group of the National Machine Tool Builders' Assn.

MACHINERY'S DATA SHEETS 441 and 442

DOUBLE DEPTH OF THREAD FOR DIFFERENT PERCENTAGES OF FULL THREAD

Figures in table show amount to deduct from outside diameter of tap to obtain tap drill diameter. Double depth of thread = 0.01299 × percentage of full thread ÷ number of threads per inch. *Example:* To find the tap drill size for a 1⅛-inch, 32-thread screw with 80 per cent thread, follow first column down to 32, then across to column for 80 per cent thread. This figure, 0.0323, when deducted from the diameter, 1.125, gives 1.0927, which is the required tap drill diameter in inches.

Threads per Inch	Double Depth of Thread, in Inches								
	50 Per Cent of Thread	55 Per Cent of Thread	60 Per Cent of Thread	65 Per Cent of Thread	70 Per Cent of Thread	75 Per Cent of Thread	80 Per Cent of Thread	83.3 Per Cent of Thread	Full Thread
10	0.0649	0.0714	0.0779	0.0844	0.0909	0.0974	0.1039	0.1082	0.12990
11	0.0590	0.0649	0.0708	0.0767	0.0826	0.0885	0.0944	0.0984	0.11809
12	0.0541	0.0595	0.0649	0.0702	0.0755	0.0808	0.0861	0.0914	0.10825
13	0.0499	0.0549	0.0599	0.0649	0.0699	0.0749	0.0799	0.0831	0.09992
14	0.0464	0.0510	0.0556	0.0602	0.0648	0.0694	0.0740	0.0773	0.09278
16	0.0406	0.0446	0.0486	0.0526	0.0566	0.0606	0.0646	0.0676	0.08119
18	0.0361	0.0396	0.0431	0.0466	0.0501	0.0536	0.0571	0.0606	0.07217
20	0.0325	0.0357	0.0389	0.0421	0.0453	0.0485	0.0517	0.0549	0.06495
24	0.0270	0.0298	0.0326	0.0354	0.0382	0.0410	0.0438	0.0466	0.05412
27	0.0240	0.0264	0.0288	0.0312	0.0336	0.0360	0.0384	0.0400	0.04811
28	0.0232	0.0254	0.0276	0.0298	0.0324	0.0347	0.0370	0.0386	0.04639
30	0.0216	0.0238	0.0260	0.0282	0.0304	0.0326	0.0348	0.0360	0.04330
32	0.0203	0.0223	0.0243	0.0263	0.0283	0.0303	0.0323	0.0338	0.04059
36	0.0180	0.0198	0.0216	0.0234	0.0252	0.0270	0.0288	0.0300	0.03608
40	0.0162	0.0178	0.0194	0.0210	0.0226	0.0242	0.0258	0.0270	0.03247
44	0.0147	0.0162	0.0177	0.0192	0.0207	0.0222	0.0237	0.0246	0.02952
48	0.0135	0.0148	0.0161	0.0174	0.0187	0.0200	0.0213	0.0225	0.02706
50	0.0130	0.0142	0.0154	0.0166	0.0178	0.0190	0.0202	0.0216	0.02598
56	0.0116	0.0127	0.0138	0.0149	0.0160	0.0171	0.0182	0.0193	0.02319
64	0.0101	0.0111	0.0121	0.0131	0.0141	0.0151	0.0161	0.0169	0.02029
72	0.0090	0.0099	0.0107	0.0115	0.0123	0.0131	0.0139	0.0150	0.01804
80	0.0081	0.0089	0.0097	0.0105	0.0113	0.0121	0.0129	0.0135	0.01623

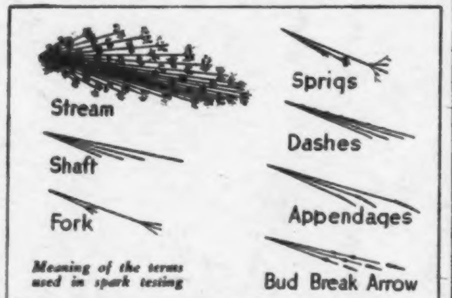
MACHINERY'S Data Sheet No. 441, May, 1941

Compiled by R. G. Haskins Co., Chicago, Ill.

SIMPLE TESTS FOR IDENTIFYING METALS

Spark tests should be made on a high speed power grinder, and the specimen should be held so that the sparks will be given off horizontally. For most accurate results, the sparks should be examined against a dark background, preferably in a dark corner of the shop.

The color, shape, average length, and activity of the sparks are details which are characteristics of the material tested. Spark testing can be a very accurate method of identifying metals but it requires considerable practice and experience to become an expert. Several common sparks are given in the table. If the operator learns the technique for identifying these metals readily, he will soon be able to expand his experience to include others by observation and comparison with the sparks from known samples.



Meaning of the terms used in spark testing

Wrought Iron	Low-Carbon Steel*	High-Carbon Steel	Alloy Steel**
Color - straw yellow. Average stream length with power grinder-65 in. Volume-large. Long shafts ending in forks and arrowlike appendages. Color-white	Color-white. Average length of stream with power grinder-70 in. Volume-moderately large. Shafts shorter than wrought iron and in forks and appendages. Forks become more numerous and sprigs appear as carbon content increases	Color-white. Average stream length with power grinder-55 in. Volume-large. Numerous small and repeating sprigs	Color - straw yellow. Stream length varies with type and amount of alloy content. Shafts may end in forks, buds or arrows, frequently with break between shaft and arrow. Few, if any, sprigs. Color-white
White Cast Iron	**Gray Cast Iron**	**Malleable Iron**	**Nickel*****
Color-red. Color - straw yellow. Average stream length with power grinder-20 in. Volume-very small. Sprigs-finer than gray iron, small and repeating	Color-red. Color - straw yellow. Average stream length with power grinder-25 in. Volume-small. Many sprigs, small and repeating	Color - straw yellow. Average stream length with power grinder-30 in. Volume-moderate. Longer shafts than gray iron ending in numerous small, repeating sprigs	Color-orange. Average stream length with power grinder-10 in. Short shafts with no forks or sprigs

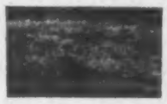
*In general, the same as for cast steel
**Spark shown is for stainless steel
***Monel metal spark is very similar to nickel

MACHINERY'S Data Sheet No. 442, May, 1941

Compiled by The Linde Air Products Co., New York City

MACHINERY'S DATA SHEETS 443 and 444

SIMPLE TESTS FOR IDENTIFYING METALS—1

		White Cast Iron*	Gray Cast Iron	Malleable Iron†	Wrought Iron	Low-Carbon Steel and Cast Steel
Appearance	**Fracture**	Very fine, silvery white, silky crystalline formation	 Dark gray	 Dark gray	 Bright gray	 Bright gray
	Unfinished Surface	Evidence of sand mold; dull gray	Evidence of sand mold; very dull gray	Evidence of sand mold; dull gray	Light gray; smooth	Dark gray; forging marks may be noticeable; cast—evidences of mold
	Newly Machined Surface	Rarely machined	Fairly smooth; light gray	Smooth surface; light gray	Very smooth surface; light gray	Very smooth; bright gray
Chip Test	**Appearance of Chip**	Small broken fragments	Small partially broken chips, but possible to chip a fairly smooth groove	Chips do not break short as in cast iron	Smooth edges where cut	Smooth edges where cut
	Size of Chip		1/8 inch	1/4 to 3/8 inch	Can be continuous if desired	Can be continuous if desired
	Facility of Chipping	Brittleness prevents chipping a path with smooth sides	Not easy to chip because chips break off from base metal	Very tough; therefore harder to chip than cast iron	Soft and easily cut or chipped	Easily cut or chipped

*Very seldom used commercially. †Malleable iron should always be bronze-welded.

MACHINERY'S Data Sheet No. 443, June, 1941

Compiled by The Linde Air Products Co., New York City

SIMPLE TESTS FOR IDENTIFYING METALS—2

		White Cast Iron*	Gray Cast Iron	Malleable Iron†	Wrought Iron	Low-Carbon Steel and Cast Steel
Blowpipe Test	**Speed of Melting (From Cold State)**	Moderate	Moderate	Moderate	Fast	Fast
	Color Change while Heating	Becomes dull red before melting	Becomes dull red before melting	Becomes red before melting	Becomes bright red before melting	Becomes bright red before melting
	Appearance of Slag	A medium film develops	A thick film develops	A medium film develops	Oily or greasy appearance with white lines	Similar to molten metal
	Action of Slag	Quiet; tough, but can be broken up	Quiet; tough, but possible to break it up	Quiet; tough, but can be broken	Quiet; easily broken up	Quiet
	Appearance of Molten Puddle	Fluid and watery; reddish white	Fluid and watery; reddish white	Fluid and watery; straw color	Liquid; straw color	Liquid; straw color
	Action of Molten Puddle under Blowpipe Flame	Quiet; no sparks; depression under flame disappears when flame is removed	Quiet; no sparks; depression under flame disappears when flame is removed	Boils and leaves blow-holes; surface metal sparks; interior does not	Does not get viscous; generally quiet; may be slight tendency to spark	Molten metal sparks

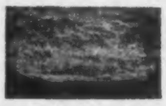
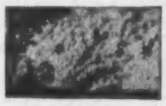
*Very seldom used commercially. †Malleable iron should always be bronze-welded.

MACHINERY'S Data Sheet No. 444, June, 1941

Compiled by The Linde Air Products Co., New York City

MACHINERY'S DATA SHEETS 445 and 446

SIMPLE TESTS FOR IDENTIFYING METALS—3

		High-Carbon Steel	Copper	Brass and Bronze	Monel Metal	Nickel
Appearance	Fracture	 Very light gray	 Red color	 Red to yellow	 Light gray	 Almost white
Appearance	Unfinished Surface	Dark gray; rolling or forging lines may be noticeable	Various degrees of reddish brown to green due to oxides; smooth	Various shades of green, brown, or yellow due to oxides; smooth	Smooth; dark gray	Smooth; dark gray
Appearance	Newly Machined Surface	Very smooth; bright gray	Bright copper red color dulls with time	Red through to whitish yellow; very smooth	Very smooth; light gray	Very smooth; white
Chip Test	Appearance of Chip	Fine grain fracture; edges lighter in color than low-carbon steel	Smooth chips; saw edges where cut	Smooth chips; saw edges where cut	Smooth edges	Smooth edges
Chip Test	Size of Chip	Can be continuous if desired	Can be continuous if desired	Can be continuous if desired	Can be continuous if desired	Can be continuous if desired
Chip Test	Facility of Chipping	Metal is usually very hard but can be chipped	Very easily cut	Easily cut; more brittle than copper	Chips easily	Chips easily

MACHINERY'S Data Sheet No. 445, July, 1941

Compiled by The Linde Air Products Co., New York City

SIMPLE TESTS FOR IDENTIFYING METALS—4

		High-Carbon Steel	Copper	Brass and Bronze	Monel Metal	Nickel
Blowpipe Test	Speed of Melting (From Cold State)	Fast	Slow	Moderate to fast	Slower than steel	Slower than steel
Blowpipe Test	Color Change while Heating	Becomes bright red before melting	May turn black and then red; copper color may become more intense	Becomes noticeably red before melting	Becomes red before melting	Becomes red before melting
Blowpipe Test	Appearance of Slag	Similar to molten metal	So little slag that it is hardly noticeable	Various quantities of white fumes, though bronze may not have any	Gray scum; considerable amounts	Gray scum; less slag than Monel Metal
Blowpipe Test	Action of Slag	Quiet	Quiet	Appears as fumes	Quiet; hard to break	Quiet; hard to break
Blowpipe Test	Appearance of Molten Puddle	Lighter than low-carbon steel; has a cellular appearance	Has mirrorlike surface directly under flame	Liquid	Fluid under slag	Fluid under slag film
Blowpipe Test	Action of Molten Puddle Under Blowpipe Flame	Sparks more freely than low-carbon steel	Tendency to bubble; puddle solidifies slowly and may sink slightly	Like drops of water; with oxidizing flame will bubble	Quiet	Quiet

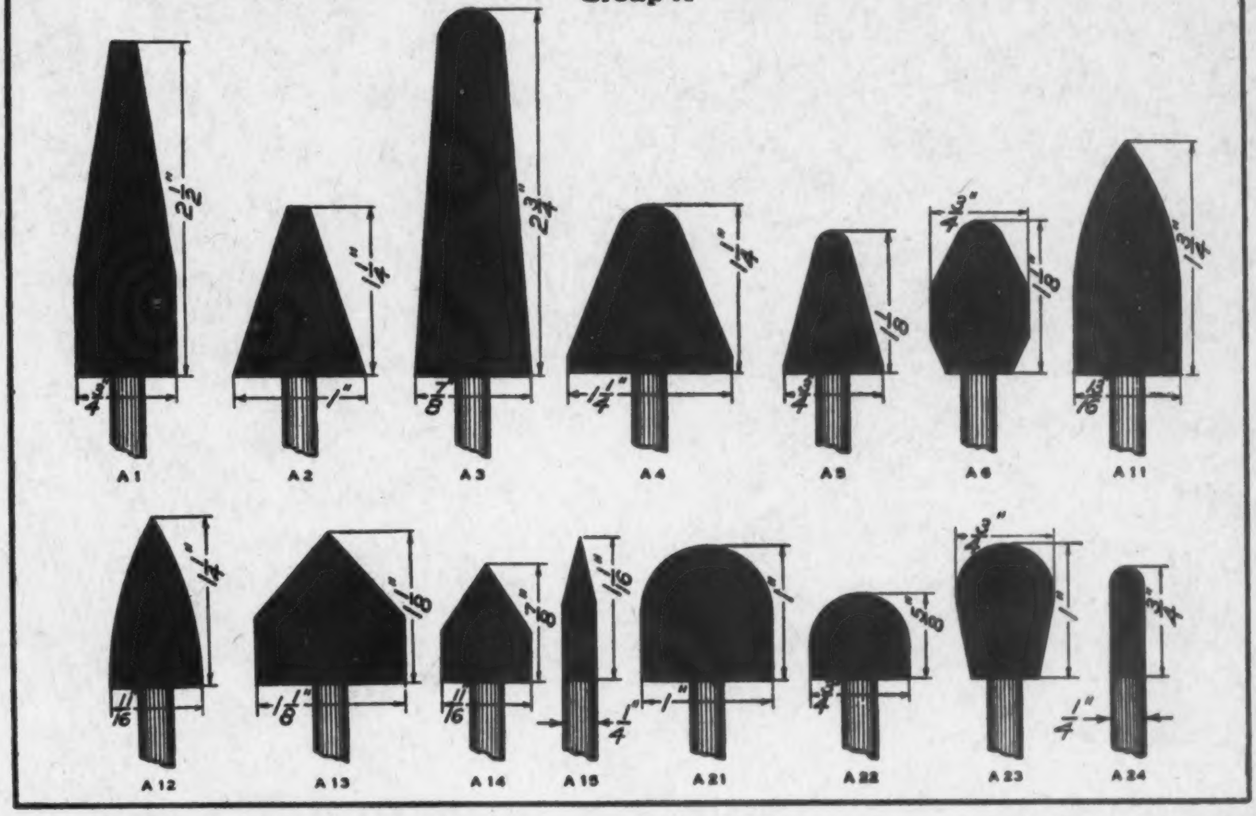
MACHINERY'S Data Sheet No. 446, July, 1941

Compiled by The Linde Air Products Co., New York City

MACHINERY'S DATA SHEETS 447 and 448

MOUNTED GRINDING WHEELS AND POINTS—1

Group A

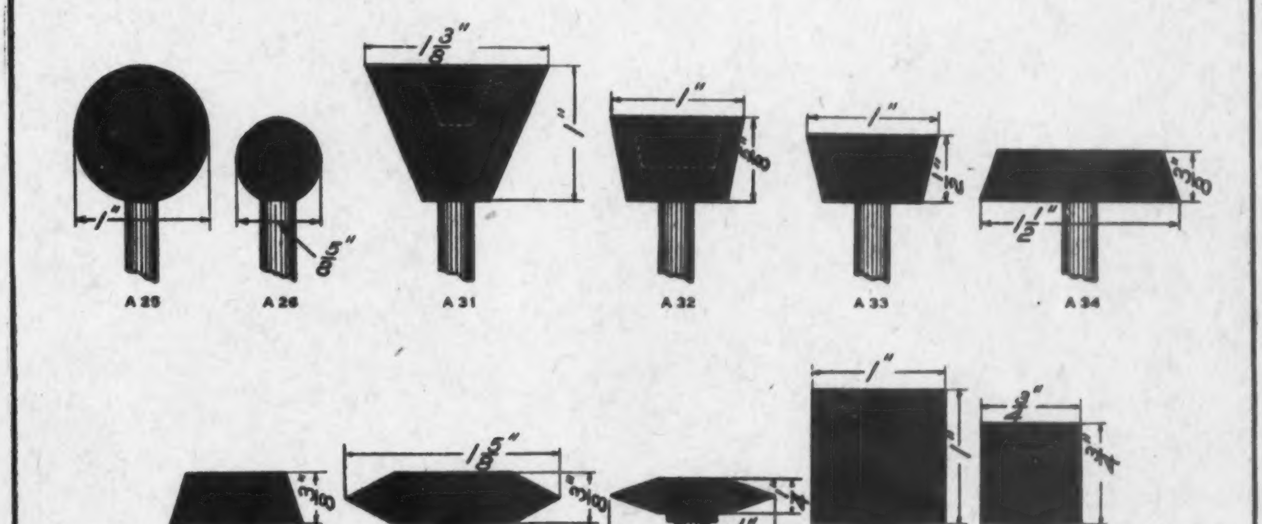


MACHINERY'S Data Sheet No. 447, August, 1941

Standard of the Grinding Wheel Manufacturers Association

MOUNTED GRINDING WHEELS AND POINTS—2

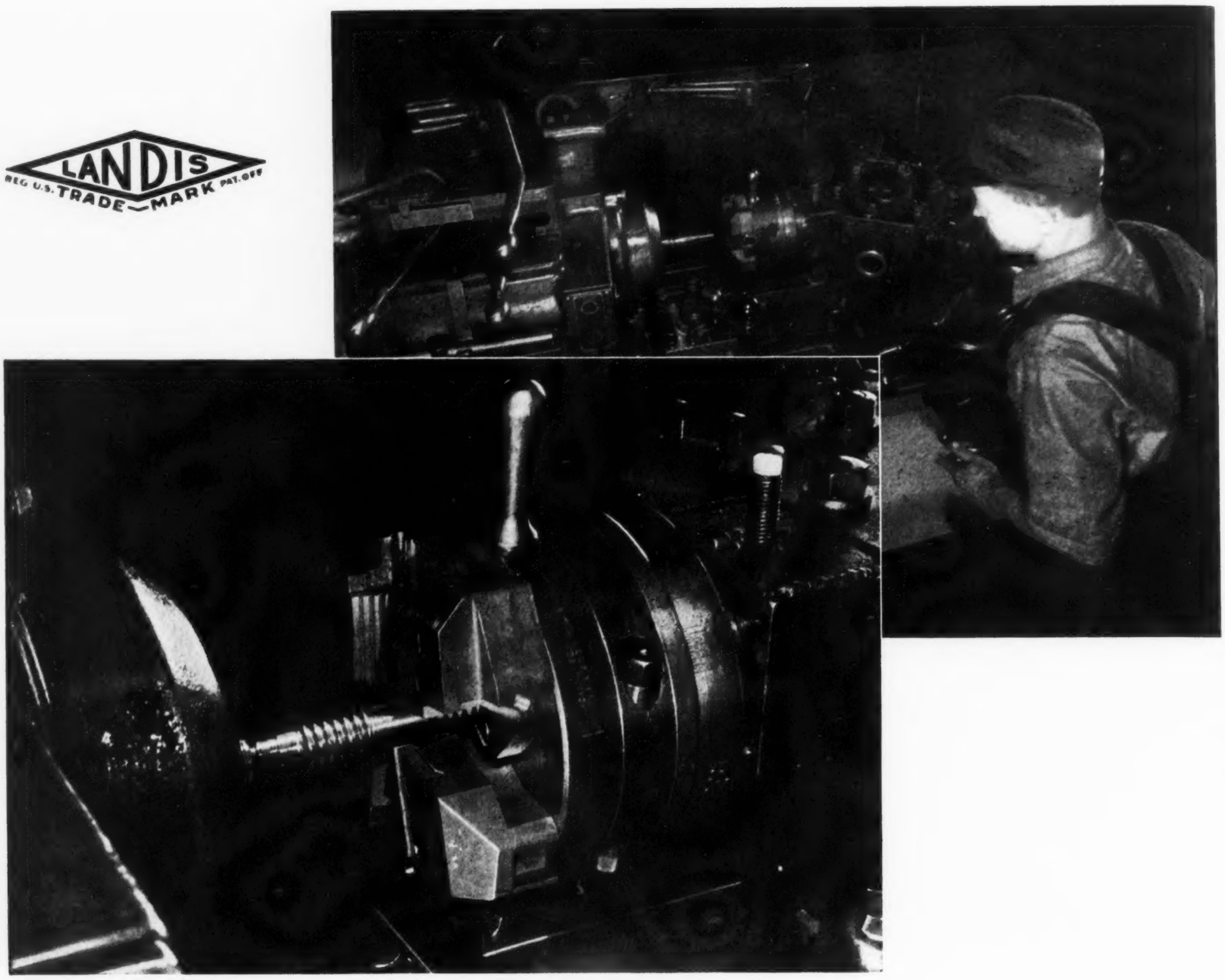
Group A



MACHINERY'S Data Sheet No. 448, August, 1941

Standard of the Grinding Wheel Manufacturers Association

LANDIS
REG. U.S. TRADE MARK PAT. OFF.



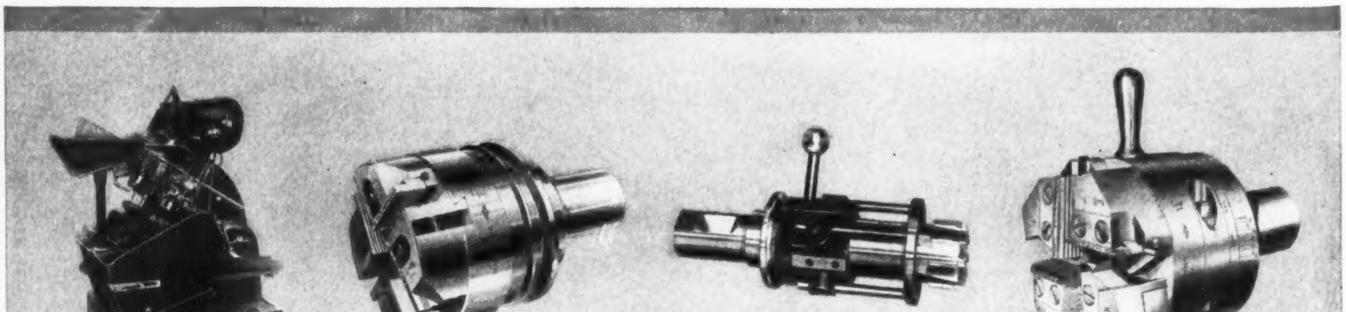
BE THREADWISE—LANDISize

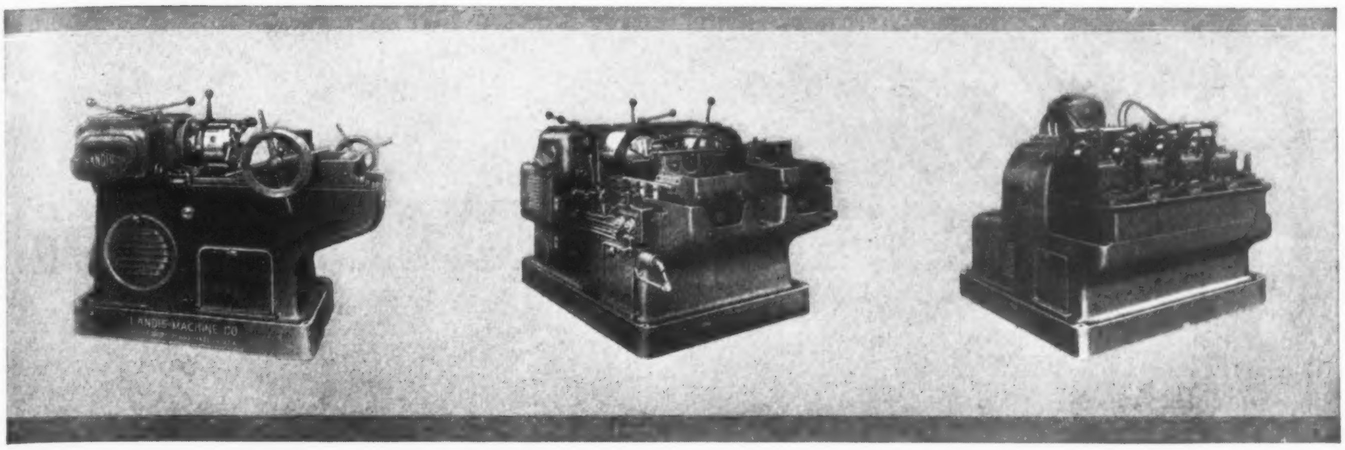
for Fine Accuracy and Dependable Thread Cutting Service

The LANDIS Line

STANDARD THREADING MACHINES
LANDMACO THREADING MACHINES
BOLT FACTORY THREADERS
AUTOMATIC FORMING AND THREADING MACHINES
PIPE THREADING AND CUTTING MACHINES
PIPE AND NIPPLE THREADING MACHINES
ROLLER PIPE CUTTERS

CHASER GRINDERS
ROTARY BOLT THREADING DIE HEADS
STATIONARY PIPE DIE HEADS
LANDMATIC HEADS FOR TURRET LATHES
LANDEX HEADS FOR AUTOMATIC SCREW MACHINES
LANCO HEADS FOR HAND-OPERATED THREADING MACHINES
LANDIS COLLAPSIBLE AND ADJUSTABLE TAPS





LANDMATIC Heads

—designed for fine Thread Accuracy
—built for dependable service

A west coast manufacturer employs the LANDMATIC Head illustrated on the opposite page to thread adjuster screws made from 3135 S.A.E. steel heat treated to Brinell 217-241.

The thread, 1¼" diameter, 5 pitch Acme 1⅞" long, is produced at a cutting speed of 10' per minute. The threads are held to close tolerance specifications.

This 2" LANDMATIC Head has been in continuous service for 15 years, assuring the manufacturer accurate dependable thread cutting service. The Landis Tangential Chaser assures low tool cost.

Investigate the LANDMATIC Head as a means for the accurate, low cost threading of your threaded parts.
Write for Bulletin No. F-90

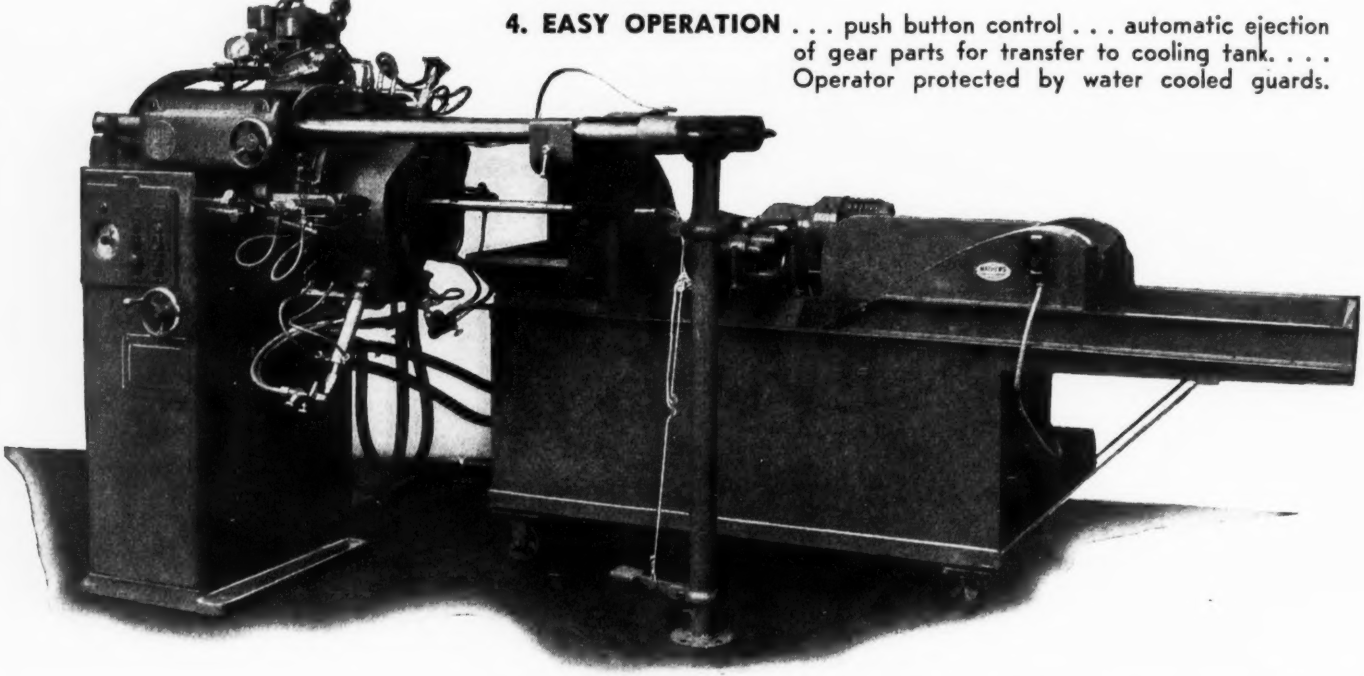
LANDIS
MACHINE COMPANY, Waynesboro Pennsylvania

Now HARDENING with M

At Low Cost, the New Fellows Flame Hardener produces uniform localized hardening under automatic, precision control.

A boon to manufacturers of gears, shafts and other circular parts, because it offers:

1. **IDEAL FLEXIBILITY** . . . since a complete change over for any given part takes less than 30 minutes. Torches and flame-tips are easily adjustable to any position required.
2. **WIDE-RANGE CAPACITY** . . . taking parts up to 10½ inches in diameter, and shafts up to 36 inches long. Flame area up to 2 inches width on large diameter parts, and 4 inches width where diameter is 4 inches or less.
3. **UNIFORM HEATING** . . . controlled as to distribution and depth. Automatic electric timing makes for identical results throughout a production run.
4. **EASY OPERATION** . . . push button control . . . automatic ejection of gear parts for transfer to cooling tank. . . . Operator protected by water cooled guards.



FELLOWS

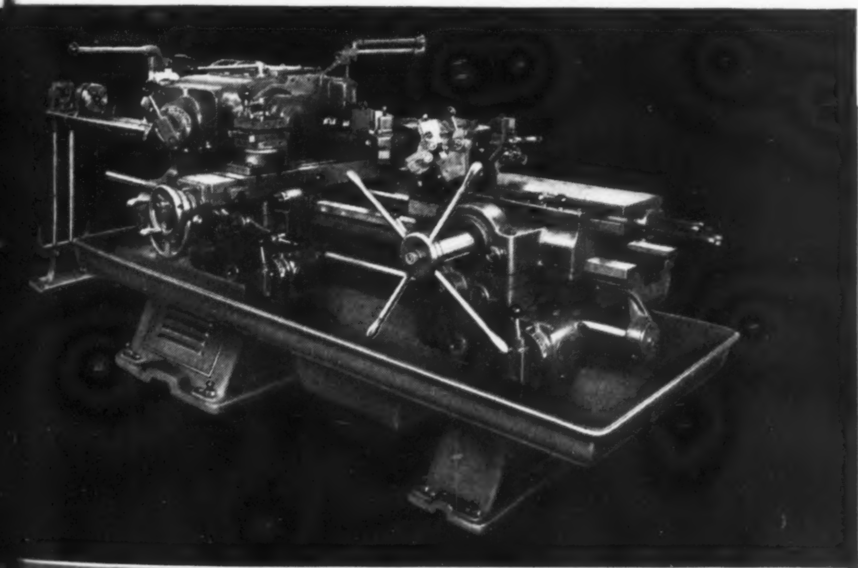
MACHINES AND TOOLS FOR GEAR PRODUCTION

is still cutting costs for you!

Most of the machines built by Lemuel Hedge have long been obsolete. Obsolete also are the pioneer models of Vermont men who followed Hedge — men like Hubbard, Robbins, Lawrence, Howe and Hartness. Yet their original designs survive today, to cut costs for you, in modern Jones & Lamson Machine Tools — improved, advanced and speeded up through ceaseless development by present day Jones & Lamson engineers.

Because of these improvements, every modern Jones & Lamson machine embodies exceptional reserves of speed, rigidity and useful power. With these modern machines you can take *full* advantage of the hard alloy cutting tools now available *or in prospect*. With these machines you can meet the present demand for defense production and still be ready to compete successfully for postwar business.

To deal with today's emergency and protect your future profits, put your production problems up to Jones & Lamson engineers. Inquiries from large companies or small receive prompt attention here.

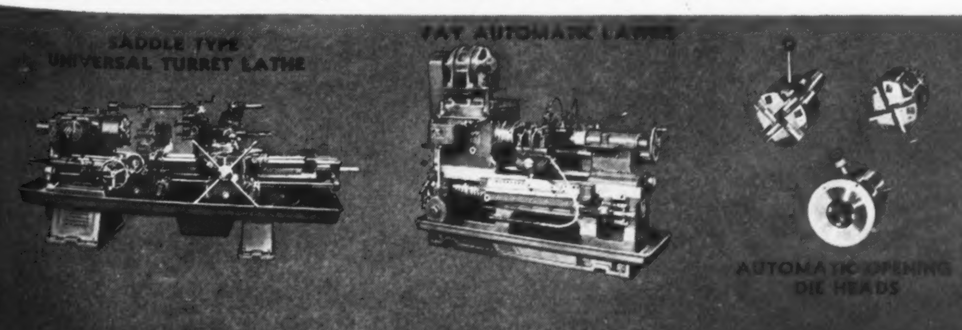


No. 3 Jones & Lamson Ram Type Universal Turret Lathe with standard bar equipment.

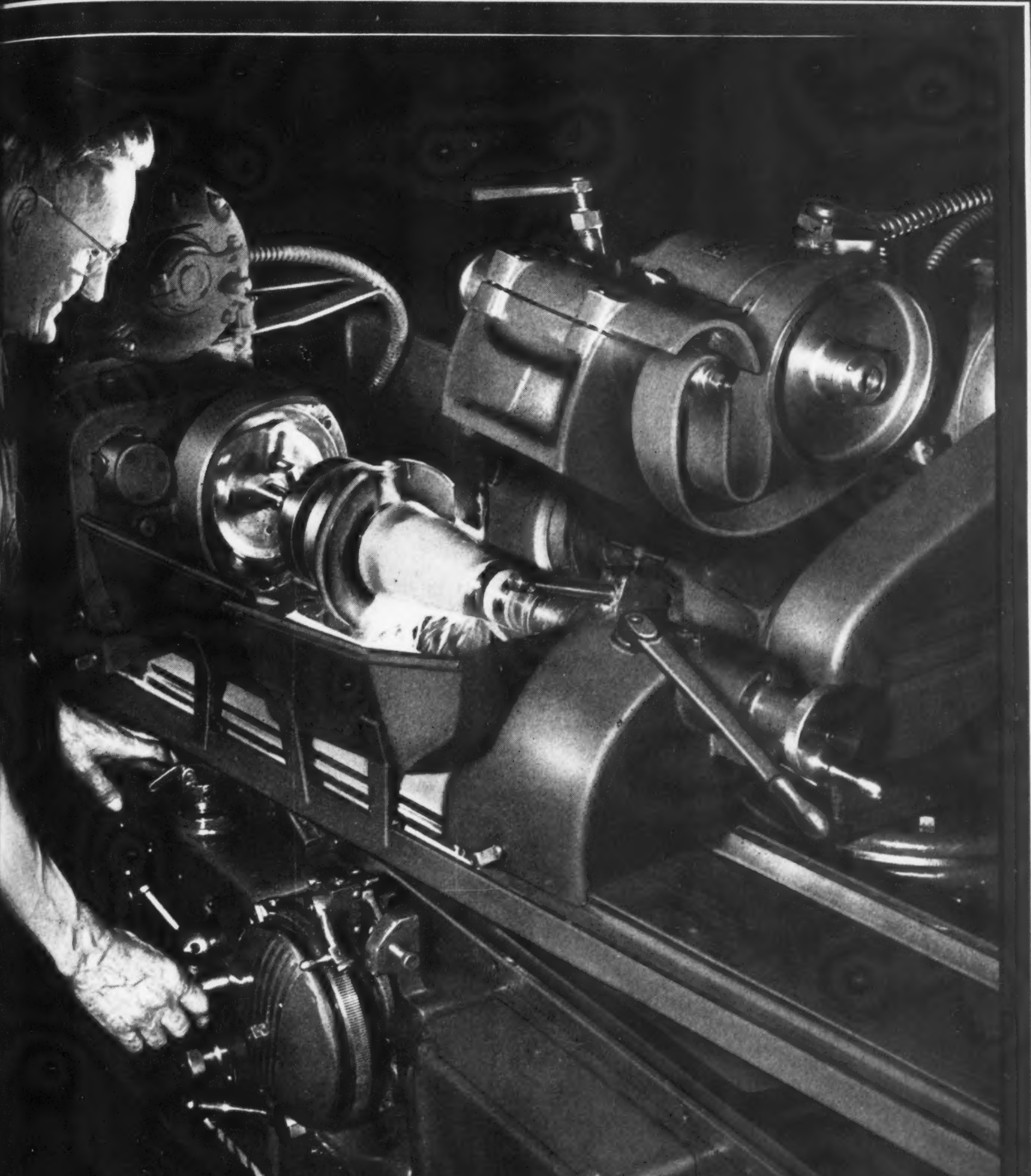
Manufacturers of Ram & Saddle Type Universal Turret Lathes . . . Fay Automatic Lathes . . . Automatic Thread Grinding Machines . . . Comparators . . . Automatic Opening Threading Dies and Chasers

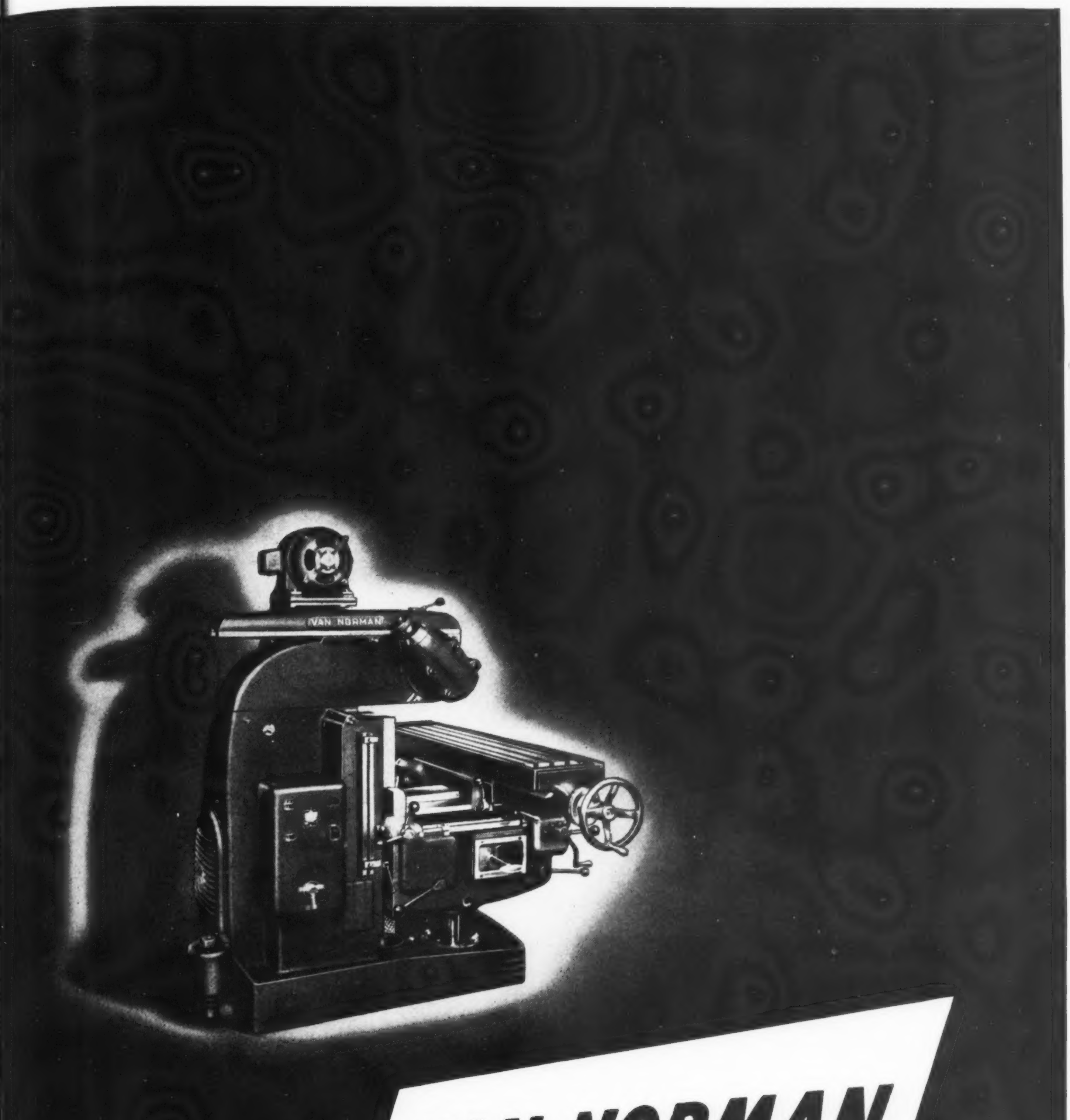
MACHINE COMPANY

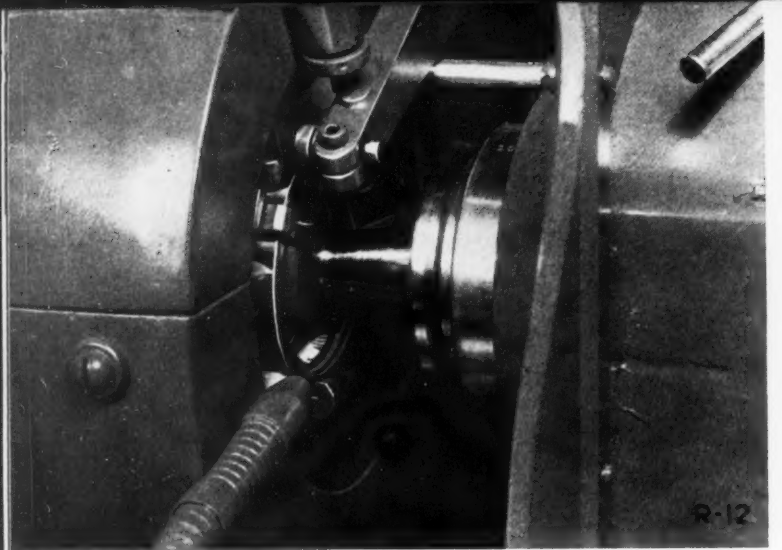
SPRINGFIELD, VERMONT, U. S. A.

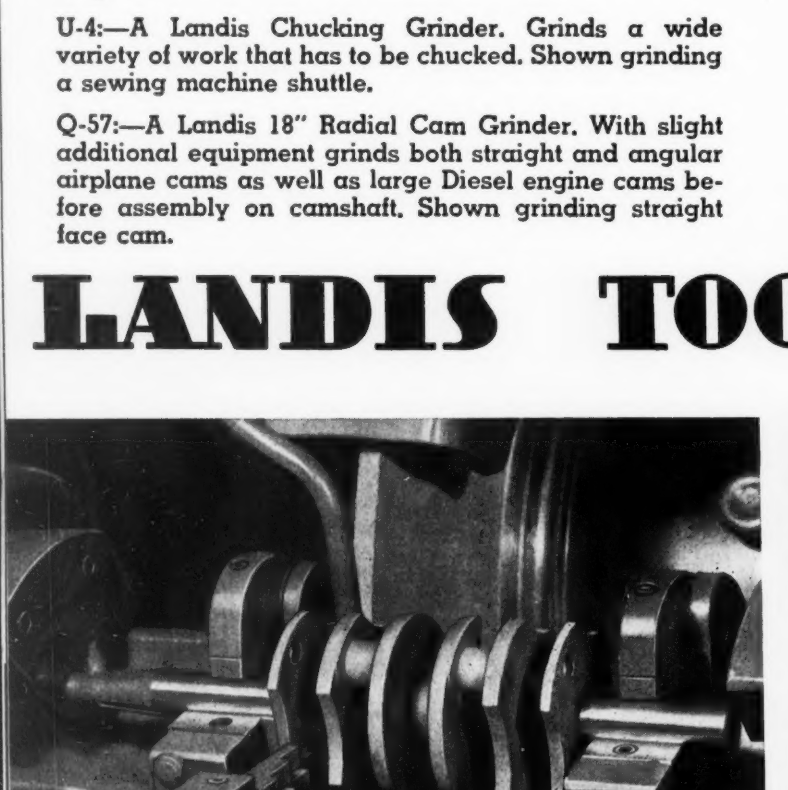
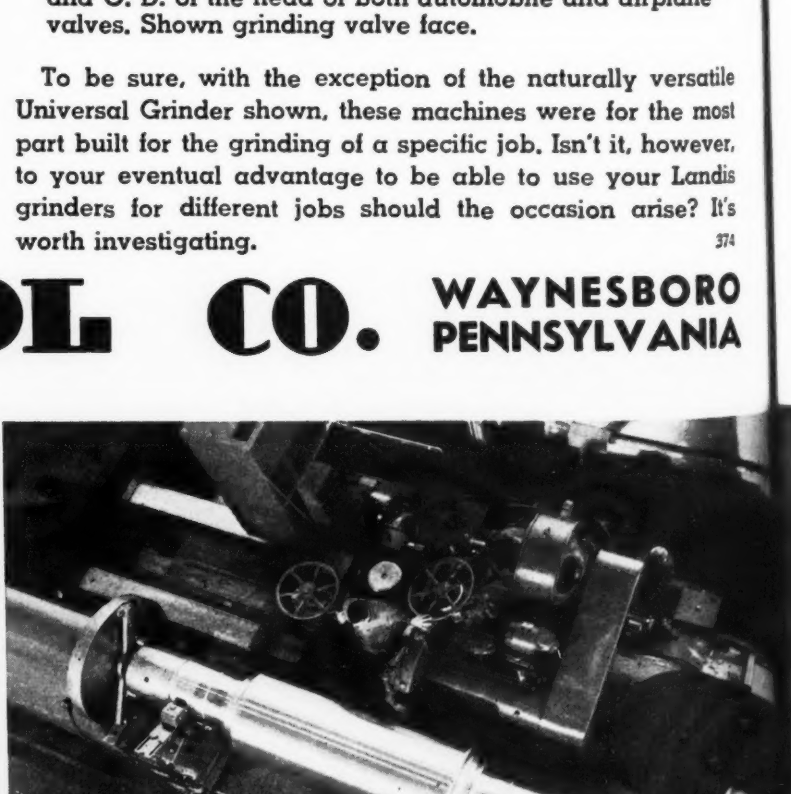


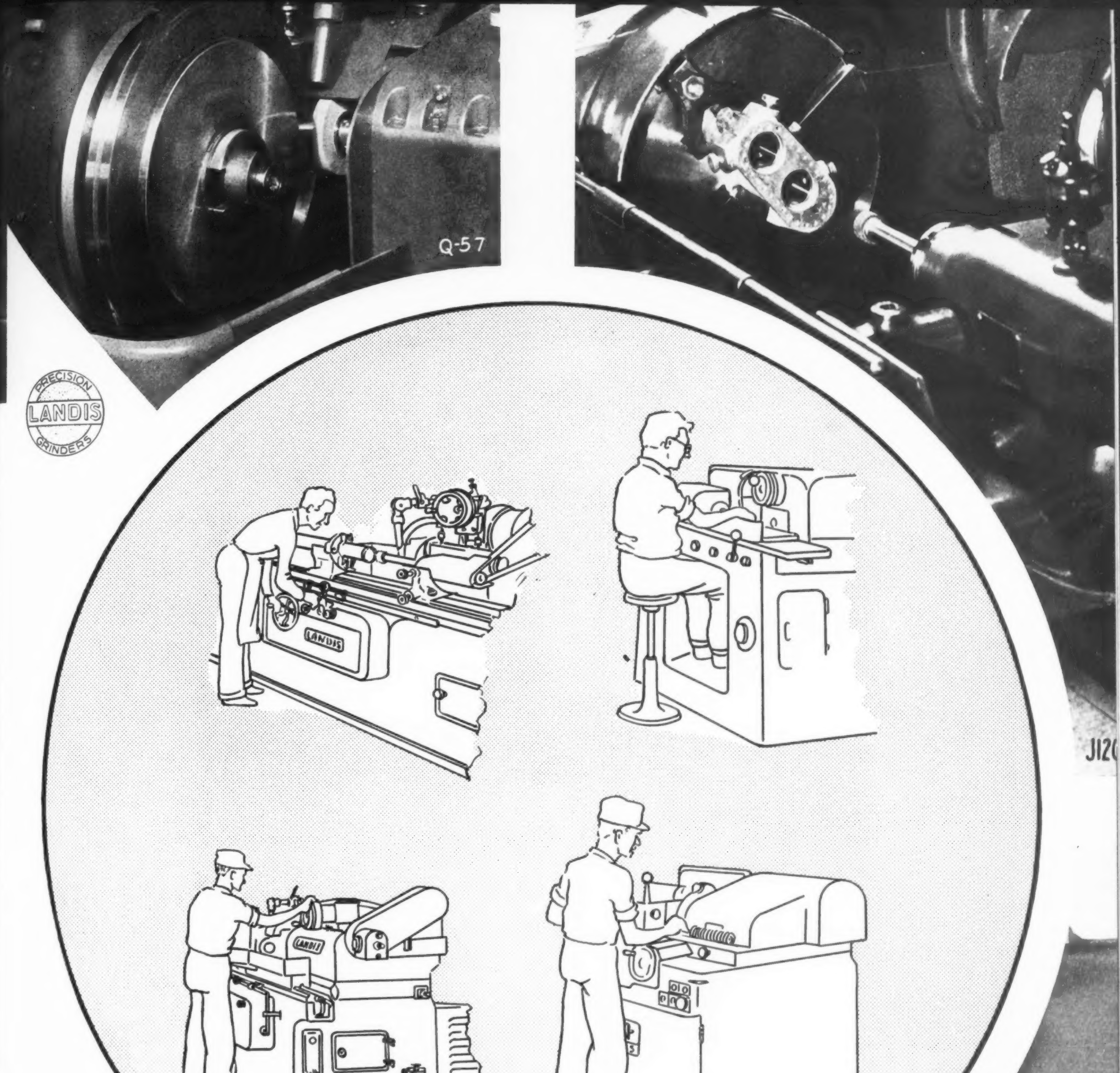
PROFIT PRODUCING
MACHINE TOOLS



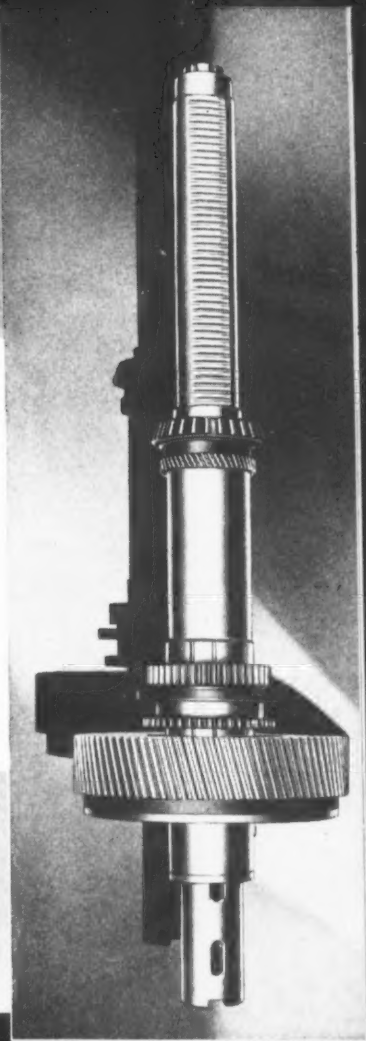

VAN NORMAN
VAN NORMAN
Milling Machines
SPRINGFIELD, MASS.


R-12



N-29



Q-57
J12
PRECISION
LANDIS
GRINDERS
LANDIS
LANDIS
PRECISION
LANDIS
GRINDERS
A-23
G-4

An Engineering Scoop!

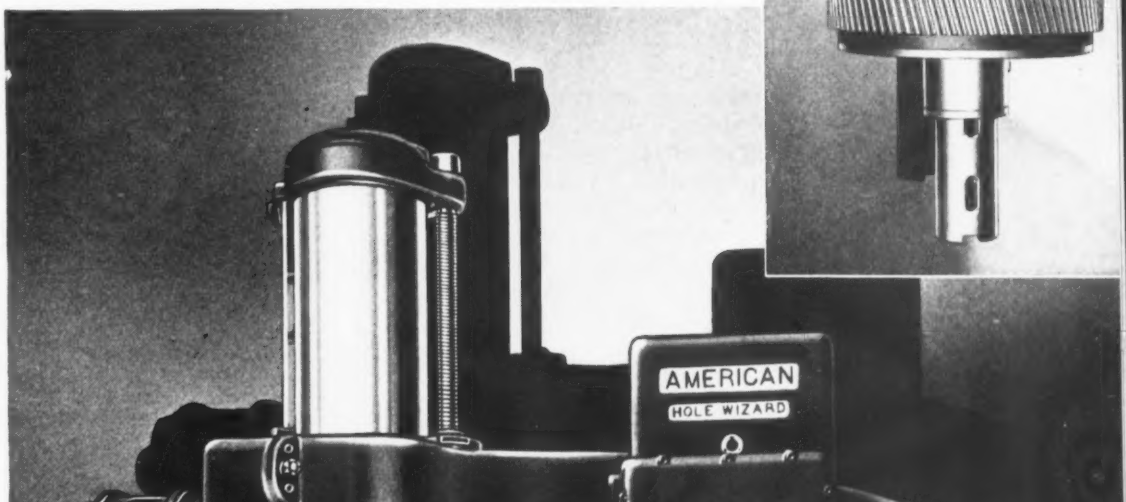


THE DOUBLE LOW HUNG SPINDLE DRIVE *of the* "AMERICAN" 32 SPEED HOLE WIZARD

It consists of two gears located on the lower portion of the spindle at the bottom of the head, thus bringing the driving gears as close as possible to the work. By using two driving gears, a large one for the low speeds and a small one for the high speeds, severe operations are performed at low tooth pressures and high speed work at low gear velocities. This ideal combination cannot be secured in any other way.

Spindle and spindle sleeve are of "Nitralloy" steel nitrided for extreme surface hardness. The spindle is ground to very close limits and the sleeve is honed to precision limits. These units being hardened are practically impervious to wear. The hardening of these members also permits a much closer fit, resulting in a precision mounting that lends itself to the most accurate drilling and boring for tool room operations.

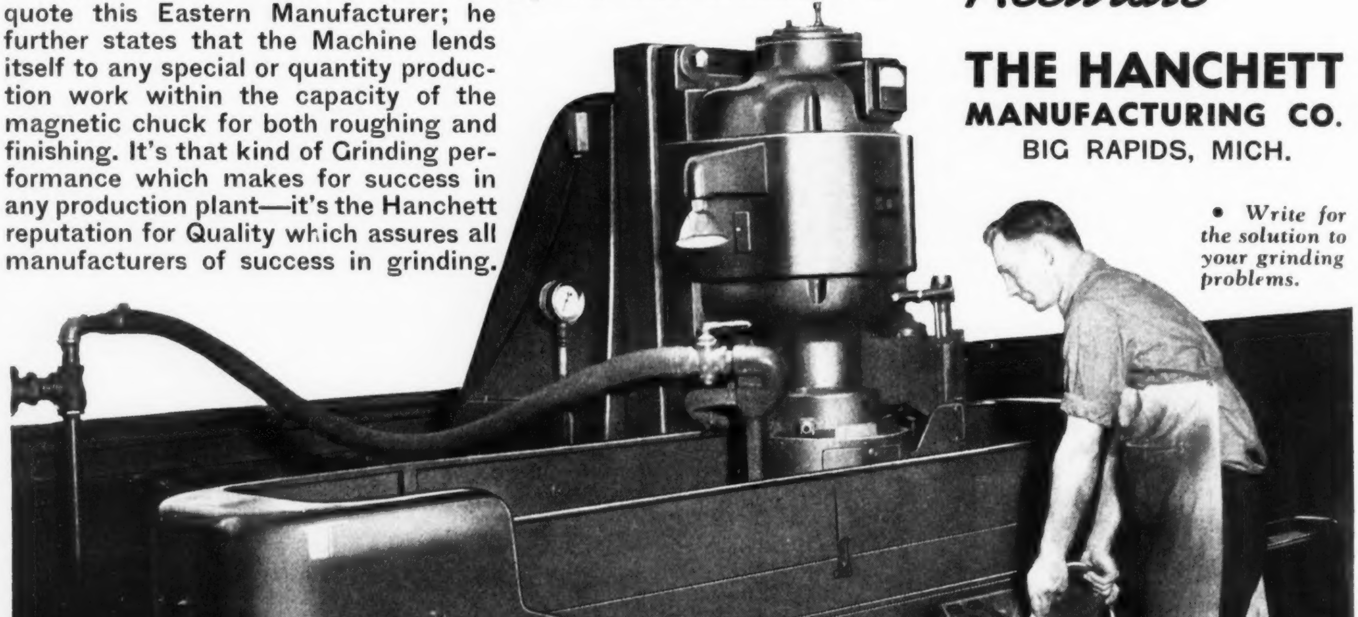
The driving sleeve is mounted on Timken Precision Roller Bearings at top and bottom with provision for take-up in case of wear. This construction insures not only a friction-free drive but also one in which the original accuracy can be easily maintained for many years.



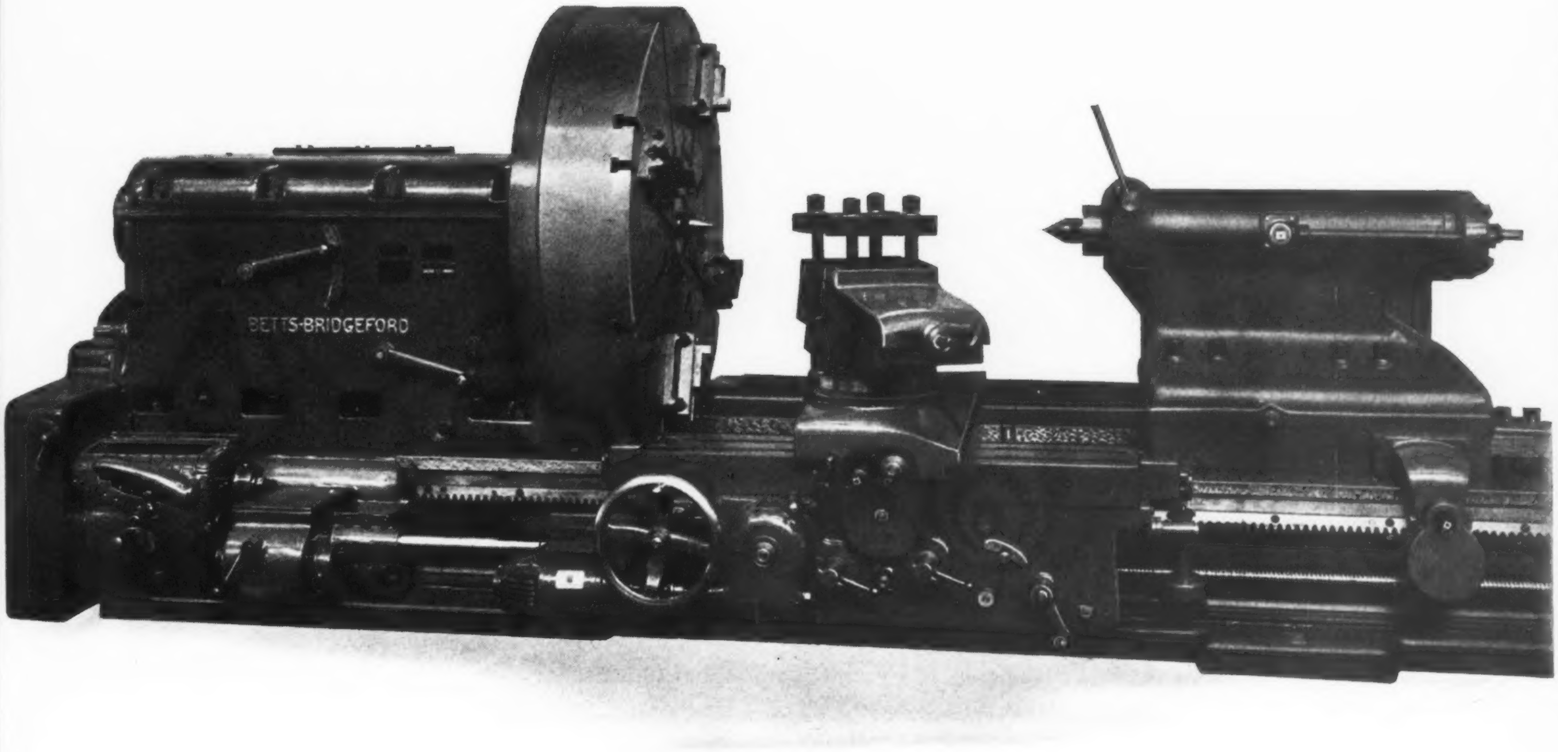
THE AMERICAN TOOL WORKS COMPANY

LATHES · RADIALS · SHAPERS

CINCINNATI, OHIO, U. S. A.



These Are Times That Try Machines



These days of increased productive effort show whether machines have those qualities that have been talked about, but never used until now.

It is in times like these that the stamina and ruggedness of machine tools are really tried and where true value and true work show up. And it is just in times like these that Betts-Bridgeford Lathes with their extra measure of strength and their capacity for handling tough jobs are truly appreciated.

Where important turning and boring jobs are being done, you will find sturdy, willing Betts-Bridgeford Turning and Boring Lathes. Hour after hour and day after day with no let up, you can see Betts-Bridgeford Lathes turning in their usual dependable performance.

Betts-Bridgeford Heavy Duty Lathes, from 26" to 120" swing, may be able to help you in your part of the Defense Program—Ask us!

BETTS • BETTS-BRIDGEFORD • NEWTON • COLBURN • HILLES & JONES • MODERN

CONSOLIDATED
MACHINE TOOL CORPORATION
ROCHESTER, NEW YORK

TIMKEN *Bearings are used in all kinds of American Defense Armament and in the machines that produce them . . .*

TIMKEN Tapered Roller Bearings give the same outstanding performance and endurance in industrial machines of all kinds that they give in American guns, tanks, armored cars, trucks, airplanes, warships and other armament.

TIMKEN
TAPERED ROLLER BEARINGS

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO


I DIDN'T THINK IT
WAS POSSIBLE TO BUILD
'EM ANY BETTER!
". . . but I was wrong! The Monarch Lathes we're shipping out today are the finest tools we've ever built." It just doesn't sound reasonable that intricate tools like Monarch Lathes can be built better and faster under the terrific pressure of our Defense Program production schedules. *But, Monarch is doing it . . .* day after day! The secret? Just many years of long-range planning, development and research. The Monarch Machine Tool Company, Sidney, Ohio.
Monarch-Keller—Form turning, boring and facing, with all the developments which make it the most universal machine ever developed.
MONARCH
LATHES

MEMORY— IS

EASTER ISLAND!—a pin-prick on the chart of the South Pacific . . . a spike of rock rising up sheer twelve thousand feet from the floor of the ocean . . . one lone pinnacle about which spin the empty horizons.

The island stands as Nature's greatest monument to the loneliness of man and the failure of his works. Cut off from all communication with the outside world save for a ship that once a year comes venturing from the Chilean Coast to make sure that its naked mountains still rise above the sea, it is the home of one of the world's unsolved mysteries—the origin of the strange monuments that mock the wreckage of all that man has done.

AXELSON HEAVY DUTY

24 Speed Selective

GEARED HEAD LATHES

AVAILABLE IN

14″ - 16″ - 18″ - 20″ - 24″ - 32″

and any desired length

Write today for your copy of the newest Lathe Folders. Latest views of the lathes together with complete descriptions and specifications are given.

BEFORE YOU BUY ANY LATHE

IS THE MOST LASTING MONUMENT!

Most monuments are erected to lost causes or to the dead. The only monument to withstand the ravages of time is the memory of man.

Today Axelson, like hundreds of other manufacturers throughout the United States, are back-ordered. But this is only a temporary situation. We honestly recognize that in our case this condition is not the sole result of a superior product or of super salesmanship. On the contrary, it merely reflects the law of supply and demand.

But although we may be back-ordered on some products, we still have others ready for immediate delivery. What are they? Optimism for the future; aggressive research and development of new materials and manufacturing methods; the idea that quality never has nor ever will be sacrificed by Axelson for quantity; the hope that old friends and new will understand the necessity of putting needs of our country before the needs of our customers.

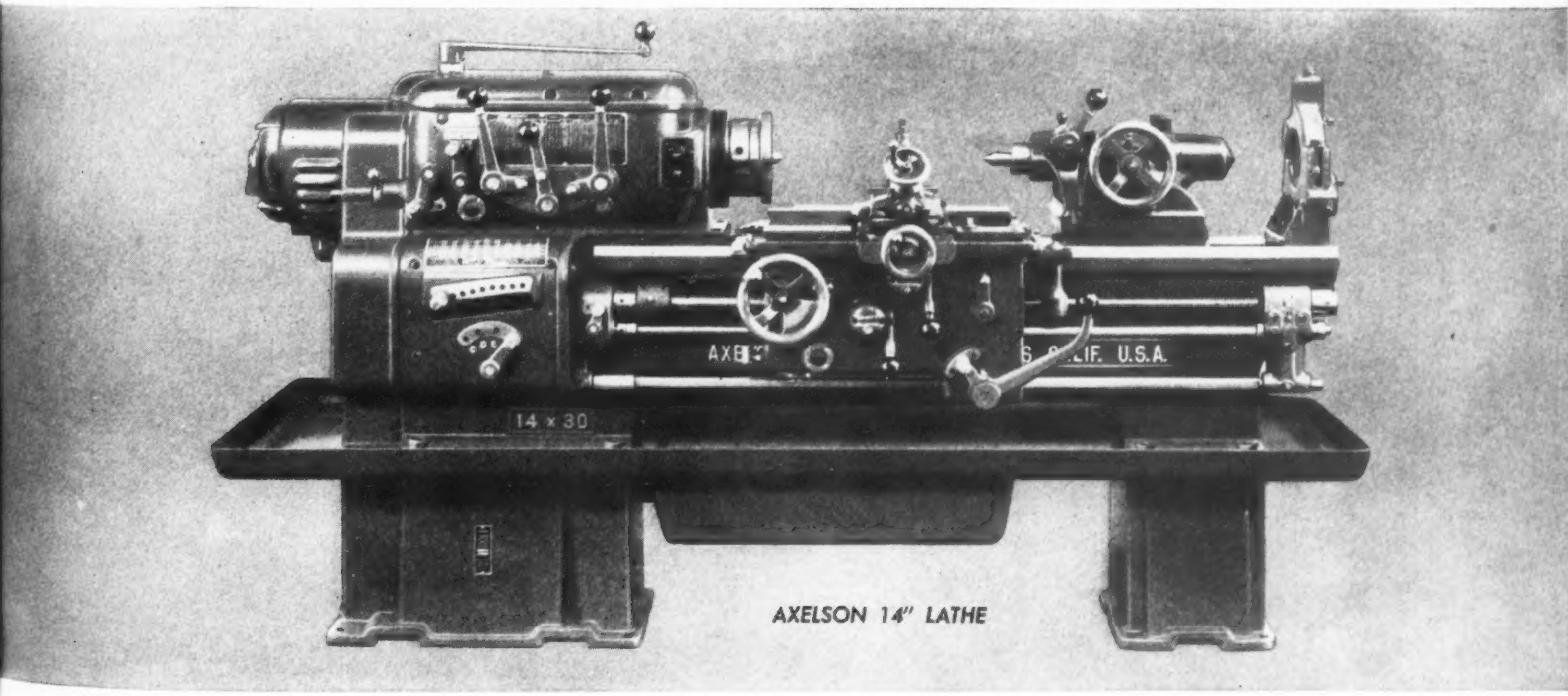
The Axelson Manufacturing Company will never be too busy to offer courtesy and consideration to the public. It will never be too busy to honestly strive to provide the best products and the best service it knows how. If you will remember those things, we, here at Axelson, can ask no better monument.

DISTRIBUTORS

The Brown Tool Company, Cleveland • Griffin & Ross Machinery Co., Los Angeles • G. H. Lynn, Direct Factory Representative, Washington, D. C. • Albert Hepworth, Philadelphia • B. C. MacDonald & Co., St. Louis • McArdle Equipment Co., Houston • Osborne Machinery Co., San Francisco • Edward W. Voss, Dormont, Pittsburgh • Wilson & Brown, Inc., New York City • Winterhoff Machinery Co., Detroit • MacKenzie Machinery Co., Boston • H. F. Wolnick Machinery Co., Chicago.

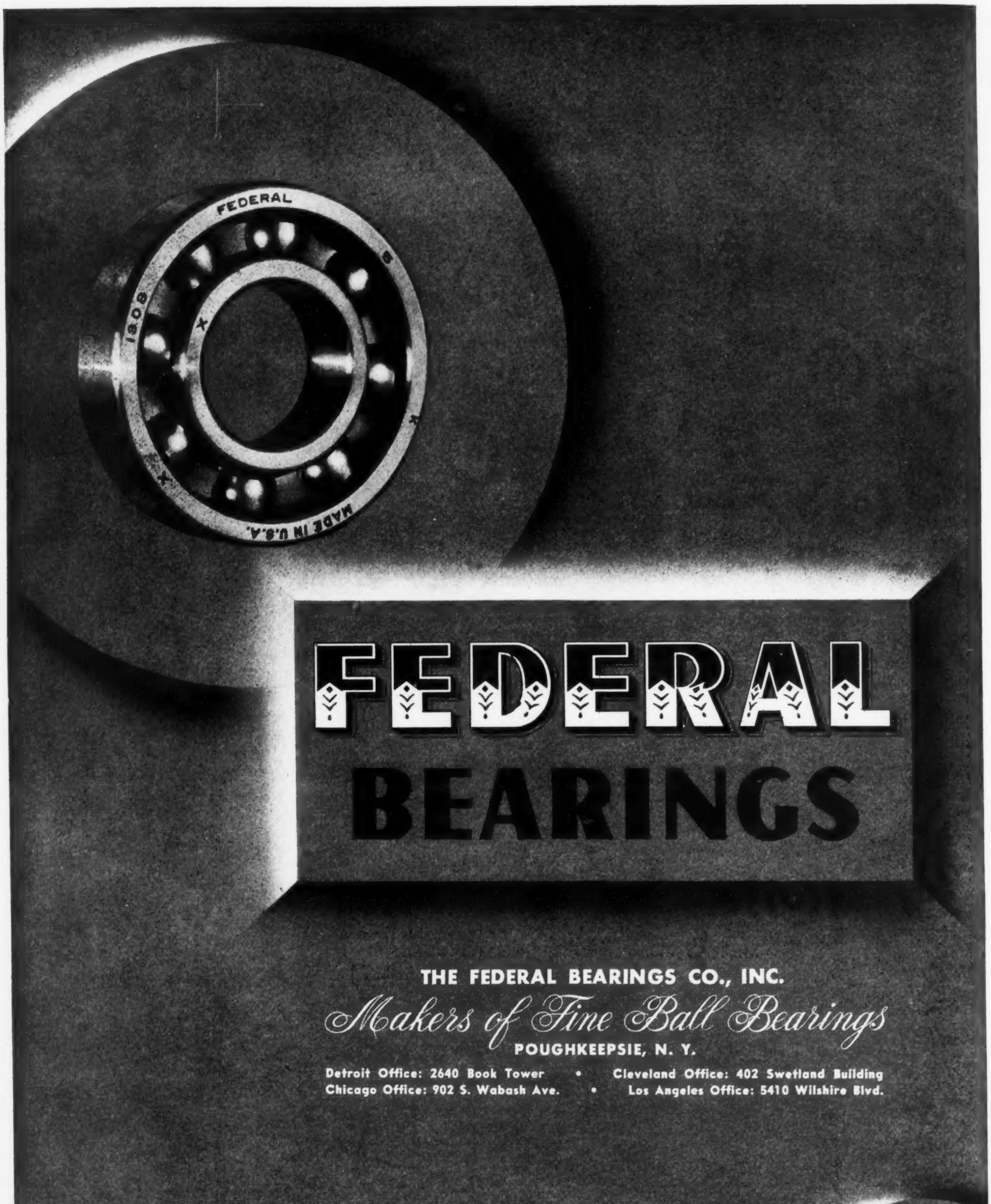
AXELSON MANUFACTURING COMPANY

6160 Boyle Avenue, Los Angeles, California (P. O. Box 98, Vernon Station) • 50 Church St., New York
3844 Walsh St., St. Louis



AXELSON 14" LATHE

INVESTIGATE AXELSON



FEDERAL
MADE IN U.S.A.
1308
FEDERAL
BEARINGS
THE FEDERAL BEARINGS CO., INC.
Makers of Fine Ball Bearings
POUGHKEEPSIE, N. Y.
Detroit Office: 2640 Book Tower • Cleveland Office: 402 Swetland Building
Chicago Office: 902 S. Wabash Ave. • Los Angeles Office: 5410 Wilshire Blvd.
TRADE MARK

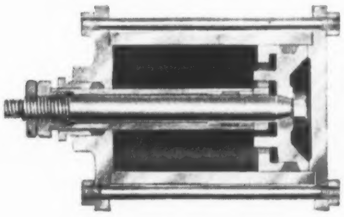
THESE CYLINDER FEATURES MEAN BETTER USE OF *Air Power*

16 in. x 7 ft. honed cylinder

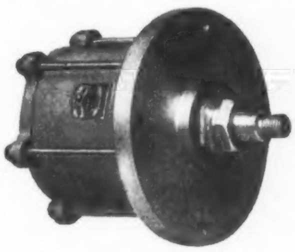
Hannifin Pneumatic Cylinders combine two features that help you get the most out of air power—precision construction and simple outside adjustment for maintaining high efficiency piston seal. Hannifin Cylinders, including even the largest sizes, are bored and then honed. The cylinder interior is straight, round, perfectly smooth, allowing the superior piston fit that prevents leakage and reduces friction loss to the minimum.

The Hannifin outside adjustment of the piston packing allows easy maintenance of the efficient piston seal. The soft, graphite-treated piston packing can be adjusted whenever necessary, from the outside of the cylinder, without disturbing any other parts. High efficiency seal can be maintained throughout the entire life of the packing, with important savings in air power, maintenance cost, and production time. The pistons can be repacked, in an emergency, with ordinary graphited packing—always available. No special parts are required.

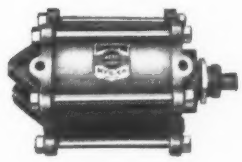
Hannifin Pneumatic Cylinders are built in a full range of standard mounting types, sizes 1 to 16 in. bore, for any length stroke. Both single and double-acting types, with or without air cushion. Write for Bulletin 34 with complete specifications.



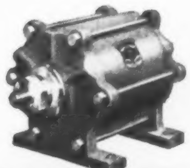
Sectional View



Model JR
double-acting cylinder



Model BR
double-acting cylinder



Model CR
double-acting cylinder

HANNIFIN MANUFACTURING COMPANY
621-631 South Kolmar Avenue • Chicago, Illinois

HANNIFIN PNEUMATIC CYLINDERS

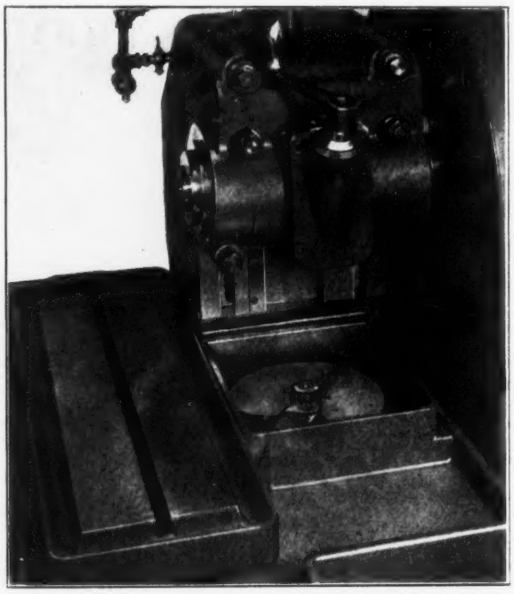
U.S. MULTI-MILLER

"NO TRIP DOG" FEATURE

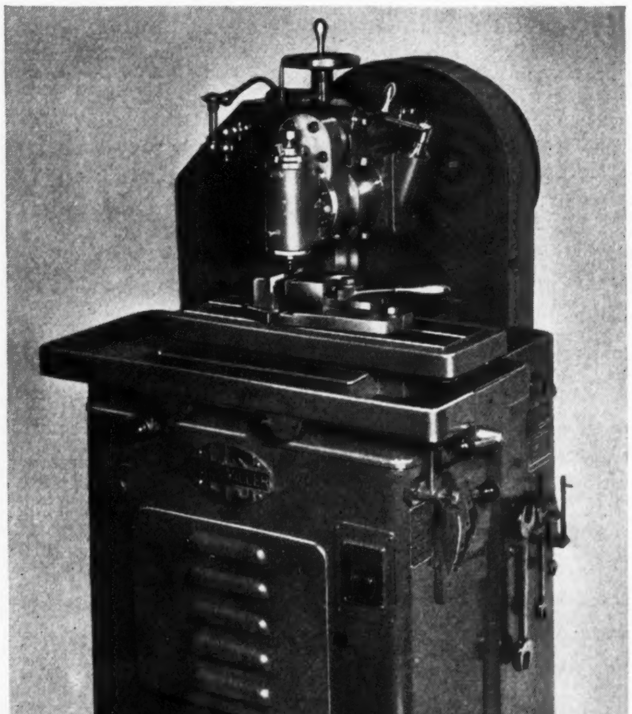
insures accuracy! *prevents running into work!* *permits faster set-up!*

The table cycle of the U. S. MULTI-MILLER is cam-actuated. Thus a fast table advance and a fast table return — plus a precise length of cut — are always accurately controlled by the contour of the table feed cam. This results in not only the saving of considerable time for set-up, but definitely prevents any accidental running into work during a fast approach, due to faulty trip dog setting. In fact, the U. S. MULTI-MILLER design entirely eliminates the need for trip dogs! Other features include: precision milling to a given point, cutting-off operations, high speed grinding, fast climb milling, hand milling, etc., and various combinations of these operations at high production rates.

Bulletin MM-40 describes all features in detail.



Close-up of cam controlling
U. S. MULTI-MILLER Table travel.



MAKERS OF
U. S. MULTI-MILLERS
U. S. MULTI-SLIDE MACHINES
U. S. AUTOMATIC PRESSROOM EQUIPMENT—U. S. COMPOUND WHEEL TRUING ATTACHMENT
U. S. DIE SETS

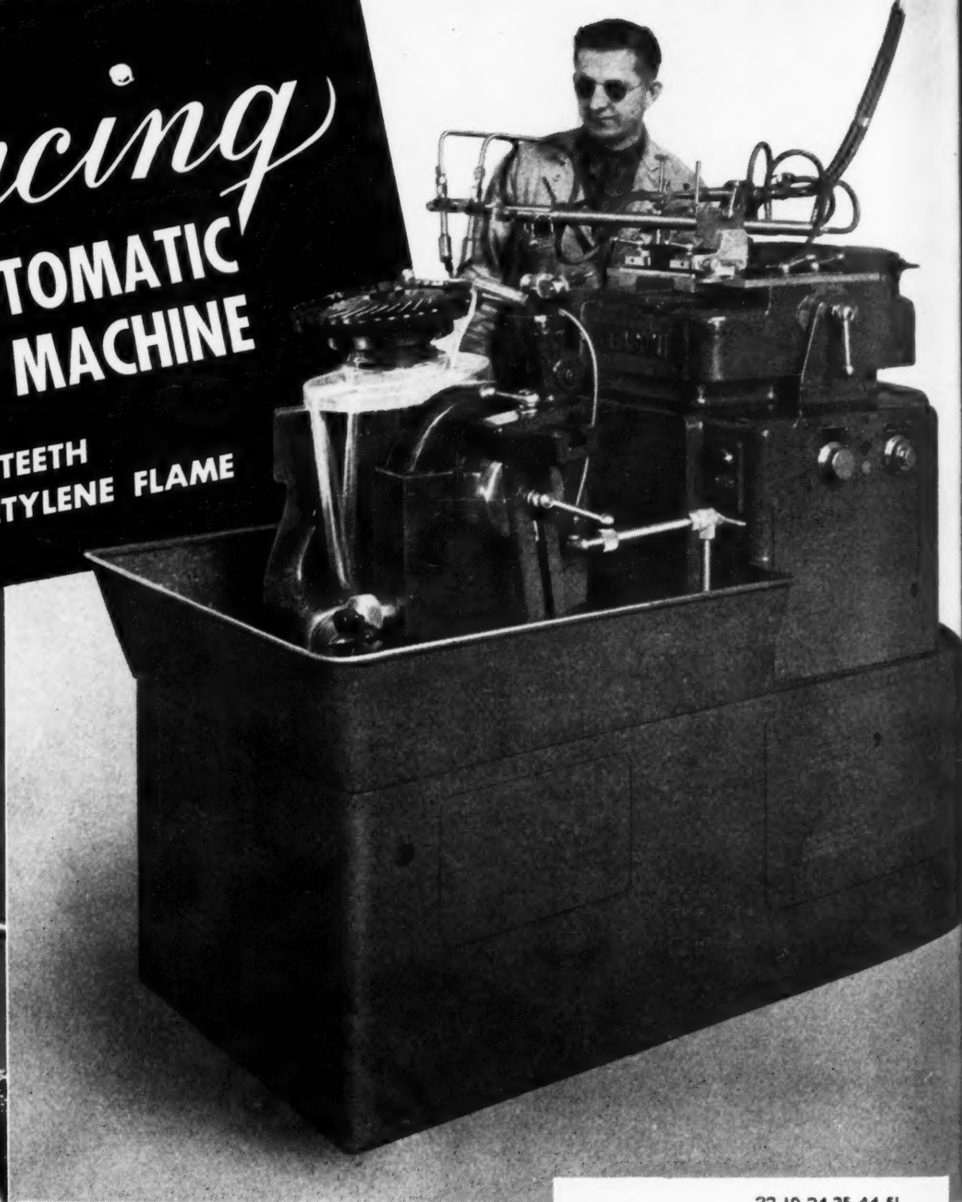
U.S. TOOL COMPANY, INC.
AMPERE, (EAST ORANGE,) N. J., U.S.A.

PRODUCTS

Announcing

THE NEW GLEASON AUTOMATIC SURFACE HARDENING MACHINE

FOR HARDENING GEAR TEETH WITH OXY-ACETYLENE FLAME



With this new machine all the advantages of flame hardening are profitably extended to medium and small-size bevel, spur and internal gears, sprockets and the like.

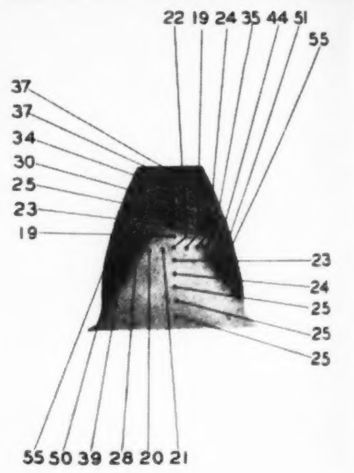
Both sides of a tooth are hardened simultaneously without distortion. Each tooth is hardened in exactly the same length of time and to the same depth as every other tooth. The machine is fully automatic in operation including indexing from tooth to tooth.

Straight-line cams guide the burners along the tooth, and on spiral bevel and helical gears the work rolls in timed relation to the torch advance so that the burners accurately follow the lengthwise tooth curve. Hydraulic control varies the burner speed to allow for heat accumulation ahead of the burners and on bevel gears to compensate for the taper of the teeth; the control also increases the burner speed at the ends of the teeth to prevent overheating.

Write for complete information.

CAPACITY

Pitch Dia., maximum	
Bevel Gears	33"
Spur and Helical Gears	26"
Internal Gears	21½"
Pitch, maximum	1½ DP
Face Width, maximum	4"
Floor Space	36" x 58"



Etched cross-section of hardened gear tooth. Rockwell "C" readings show gradual change from hard, durable tooth surface to tough, shock-resistant core.

GLEASON

GLEASON WORKS

Builders of Bevel Gear Machinery for Over Seventy-five Years

1000 UNIVERSITY AVENUE, ROCHESTER, N. Y., U. S. A.

Model 264 P-101
SNAP GAGE

This modern Snap Gage is fast and positive. Adjustable for size, positive upper anvil pressure, insures uniform gaging.

QUICKER INSPECTION

of DEFENSE MATERIAL with THESE DIAL GAGES

Fuse threads, rifle and gun bore diameters on both "grooves" and "lands", depth of recoil cylinder slots, shell diameters, concentricity, wall thickness and many other war units can be inspected quicker with Federal Dial Indicator Gages. The following are a few that will speed up your inspection.

MODEL 45 B-60	PITCH DIAMETER GAGE
MODEL 264 P-101	SNAP GAGE
MODEL 1330 P	SNAP GAGE
MODEL G3F P	GUN BORE GAGE
MODEL 36 B-6	SMALL HOLE GAGE
MODEL 1201 P	LONG HOLE GAGE
MODEL 49 P	CALIPER GAGE
MODEL 165 P	PLUG GAGE

Write us for details concerning any of these gages or send us drawings of work you wish to inspect.

FEDERAL PRODUCTS CORPORATION
1144 Eddy St. Providence, R. I.

FEDERAL

PRECISION MEASURING INSTRUMENTS

Chicago • Cleveland • Detroit • Hartford • Los Angeles • Muncie
New York • Philadelphia • Pittsburgh • Rochester • San Francisco • Seattle

We wish we could show you!

We wish you could see our plant right now. If you could, you'd understand, a lot better, why your orders have been delayed.

The situation is that our business is practically double that of last year! The rush of jobs caused by National Defense work really taxed our capacity. For a while, with all those extra orders pouring in, we were really "snowed under."

But as fast as we could, we've added more floor space—added more equipment—added more skilled men in every department. Now, with our increased plant capacity, and facilities, it looks like much clearer sailing ahead.

We want to tell all you loyal customers how much we've appreciated your helpful, cooperative attitude. We know that some of you were inconvenienced by our slow deliveries, and we're sincerely sorry. But we want you to know of our improved facilities, and to assure you that your orders will be taken care of just as efficiently and promptly as the national emergency will permit. And thanks again for your splendid cooperative spirit!

DAVIS BORING TOOL DIVISION

Larkin Packer Co., Inc., St. Louis, U. S. A.

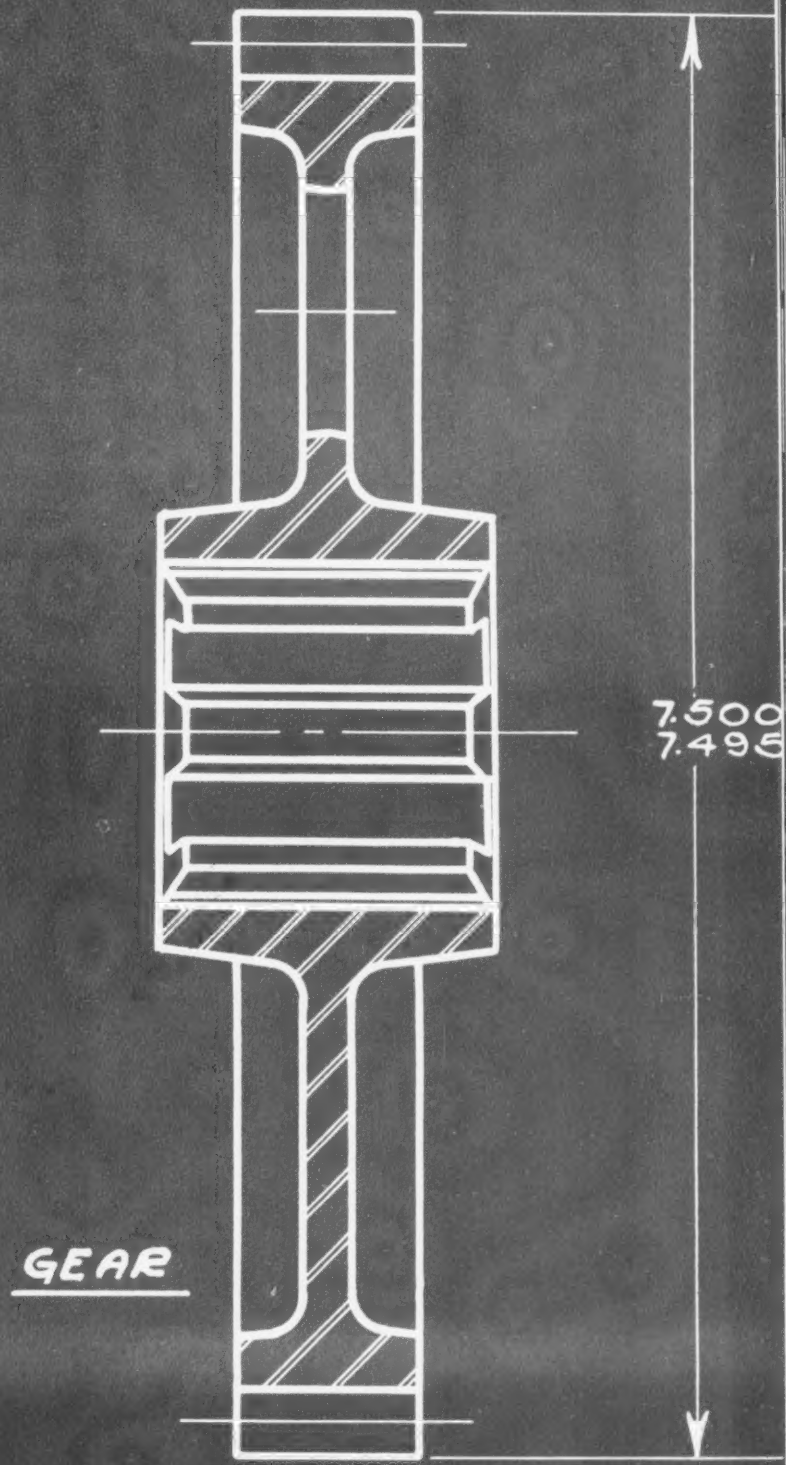
DAVIS BORING TOOLS

OF PRODUCTION

PART: Tractor Steering Clutch Driving Gear.

MATERIAL: Steel Drop Forging SAE 3115.

MACHINE: P & J Two-spindle 12" Automatic Chucking and Turning Machine.



OPERATION DATA

Grip in three holes in web with three chuck jaw.

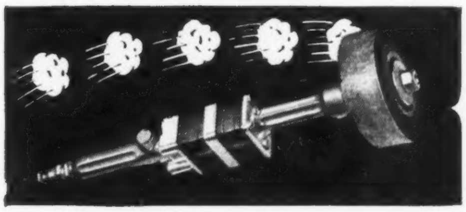
1st TF: Core drill hole (Hole pierced).
2nd TF: Rough bore hole. Rough face on end of hub. Rough turn OD of gear. Rough face both sides of gear at rim.
3rd TF: Finish cuts as roughed on 2nd TF.
4th TF: Ream hole 1.488" dia.

Floor-to-floor time, two pieces, 5.38 mins.
Production per 51-min. hour, per machine, 17.8 Gear Blanks.

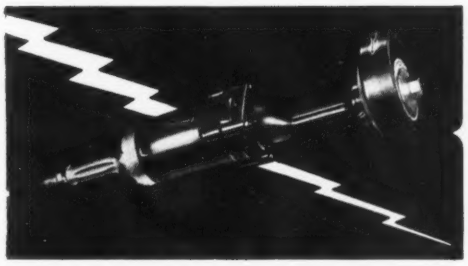
AUTOMATICS


Bearings Made
to Your Specifications
OUR plant is geared to make ball bearings of almost every type and size—to your design and specification, or designed to meet your needs. We illustrate some SCHATZ "Commercial" Ball Bearings used in coal conveyors, textile winding machines, typewriter desks, etc. Our specialty is the most economical bearing that will perform satisfactorily.
SCHATZ
"Commercial"
ANNULAR BALL BEARINGS
For the smaller manufacturer, many standard types and sizes of "Commercial" Ball Bearings are available. They are used in hundreds of different industries. We can be of service—whether you need a few, or a great many units. Write for catalog.
THE SCHATZ MANUFACTURING CO.
POUGHKEEPSIE, N. Y.
Detroit Office: 2640 Book Tower • Chicago Office: 902 S. Wabash Ave.
Cleveland Office: 402 Swetland Building

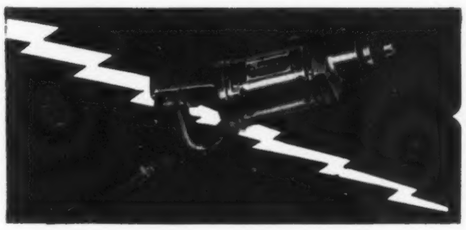
Three problems in one plant
...I licked them all with
AIR and HIGH-CYCLE



Situation No. 1. A tough buffing job, calling for heavy pressure on wheel. Plenty of air available. Recommended *Air* tools—Rotor D-100 "Power-plus" Buffers.



Later—Situation No. 2. Defense orders required expansion of another department, with 12 tools—die grinders, straight grinders, and vertical grinders. Air compressor to run 12 tools only would cost \$2497. High-Cycle generator set of twice the capacity—that is to run ultimately 24 tools—would cost \$1301 complete, and could be delivered quicker. 12 Rotor *High-Cycle* tools were installed right away.



Later—Situation No. 3. Wanted ¼" drills for work next to office. *Quiet* operation required. Suggested running a high-cycle line to this location from their generator set. So this is a quiet *High-Cycle* job for Rotor 467-D Drills.

How about YOUR problems? With *Air* and *High-Cycle,* I can supply answers which fit your portable tool problems like a glove. See how this unbiased service and Rotor Tools can speed up your production and cut your costs!

—THE ROTOR ANALYST

The Rotor Analyst has 65 different Air tools and 59 different High-Cycle tools with which to solve your problems.

THE CO.

CLEVELAND, OHIO

From Blueprint To "Tool-up" In Less Than 1 Hour!

Braze Your Own Carboloy Tools ...Get Them On Emergency Jobs *FAST!*

Emergency periods call for quick action. When a job must get under way fast—when you need Carboloy tools "yesterday"—*why not braze your own Carboloy tools?* . . . It's a simple short cut that eliminates ordering time and avoids routine "hold ups" awaiting deliveries.

Many plants now keep a stock of Carboloy Standard Blanks in their tool crib . . . ready, on a moment's notice, to make up a tool and get it on the job *fast!* . . . less than an hour for most single-point, straight-shank tools!

A Few Typical Tools You Can Make ...Using Carboloy STANDARD BLANKS

CARBOLOY STANDARD BLANKS ARE AVAILABLE IN 2 STYLES, 65 SIZES AND 3 GRADES

Just three simple steps are necessary to do this in your tool room.

1. Preparing Recess in Shanks

To accommodate the Carboloy blank in your tool shank it is necessary to provide a recess in which the Carboloy Blank can be inserted. This is a simple operation that can be done on your regular tool room milling or grinding equipment.

2. Brazing Carboloy Blank to Shank

Brazing the Carboloy Blank to your shank requires less than 5 minutes on most straight-shank, single-point tools. To do this you simply need a torch, and a few inexpensive accessories: Silver solder, flux, carbon tetrachloride, etc.

3. Grinding the Brazed Tool

Simple—fast—as easy as regrinding dull carbide tools, using the now-established, rapid grinding technique, and your regular carbide grinding equipment.

With these three simple steps you're prepared to meet emergency requirements immediately. Why wait—when you can get tools on the job *FAST*—by this simple procedure? Write for instruction booklet GT-116.

CARBOLOY COMPANY, INC.
11147 E. 8 MILE ST., DETROIT, MICH.
Chicago • Cleveland • Los Angeles • Newark
Philadelphia • Pittsburgh • Worcester
Canadian Distributor:
Canada General Electric Co., Ltd., Toronto, Canada

CARBOLOY
Reg. U. S. Pat. Off.

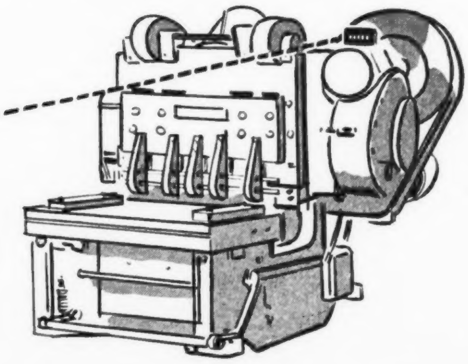
STANDARD STOCK BLANKS
2 STYLES • 65 SIZES • 3 GRADES

STARRETT MAKES IT

A Better Saw For Your Kind of Metal Cutting

STARRETT

NO NEED TO GO NEAR THIS SHEAR



...to read its production-record

They build this metal-cutting shear big and strong . . . to do the titanic job it's designed for. And to help customers keep track of the job it does, the manufacturer builds in a Veeder-Root Counting Device that records production, stroke by stroke . . . and makes these records so plainly legible that anyone can read them from 50 feet away, without having to climb all over the machine.

This Veeder-Root Large-Figure Counter has "billboard visibility" . . . large black-on-white figures that jump out to meet you. And yet the device is compact, as easy to install as it is to read, and built to stand slam-bang service without any sacrifice of accuracy. It saves time, keeps workmen out of tight places, and away from needless risk of accident. Full details, specifications and prices are given in Catalog G-40 . . . together with the scores of other types that go to make up the world's most complete line of counting devices. *Write for this catalog today.*

VEEDER-ROOT Incorporated

HARTFORD, CONNECTICUT OFFICES IN: Boston, Chicago, Cincinnati, Cleveland, Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne. In England: Veeder-Root Ltd., Croydon, Surrey. In Canada: Veeder-Root, Canada, Ltd., Montreal.


"Why didn't we call the Mill Supply Folks First . . . They'll Help Us!"
WESTERN UNION
Postal Telegraph
WESTERN UNION
Booked to next spring
Sorry we can't ship

Specify

HARDINGE COLLETS

FOR ACCURACY AND DURABILITY

The name HARDINGE on a collet is an accuracy and durability guarantee. When ordering collets only, or when ordering collets with lathes and milling machines of any make or size, specify HARDINGE Collets—they cost no more than other collets.

The stamping on the face of a HARDINGE Collet indicates that the finishing grinds were made after hardening the collet to assure concentricity.

Accuracy with durability comes from special steel, uniform heat treated threads, hardened surfaces for gripping or bearing, and spring temper for proper operation.

Write for latest HARDINGE Bulletin No. 41

Bulletin No. 41 clearly shows the styles of collets adapted in your lathes and millers. It lists the standard collets with general dimensions for identification. It gives normal round, hexagon, and square capacity of standard collets. It shows how all of your lathes and millers may be adapted for collets. Attractive prices are listed for round, hexagon, and square hole sizes. It gives the location of collet stocks in Elmira, Hartford, New York, Cleveland, Detroit, Chicago, Los Angeles, and San Francisco.

HARDINGE BROTHERS, INC.

ARMSTRONG

Extra strength and adjustability solves unusual machining problems

Every ARMSTRONG TOOL HOLDER has strength beyond all normal need: strength to stand up to any machine tool speed or feed; strength to do unusual operations as well as standard work. Each is a permanent, multi-purpose tool that reduces tooling-up to the selection of a cutter bit blade, adjusting for clearance and tightening of a set screw.

Take the job illustrated above . . . a special production job; a tool with extreme clearance, narrow enough to reach in between the high boss and the wide flange of the steel casting, and still strong and rigid enough to machine an accurate groove.

Without ARMSTRONG TOOL HOLDERS this would have presented a definite tool problem with attendant delays and interruptions of production.

With ARMSTRONG TOOL HOLDERS it required but a moment to select the "right" tool holder for the specific operation. In this case it was an ARMSTRONG Right Hand Off-set Cutting-Off Tool which, with blade extremely extended, provides the complete answer.

The ARMSTRONG System of Tool Holders provides instant "answer" for all operations on lathes, planers, slotters and shapers.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
313 N. FRANCISCO AVE. CHICAGO, U. S. A.

Eastern Warehouse and Sales:
199 Lafayette St., New York

ARMSTRONG TOOL HOLDERS Are Used in Over 96% of the Machine Shops and Tool Rooms

SEE HOW YOU S

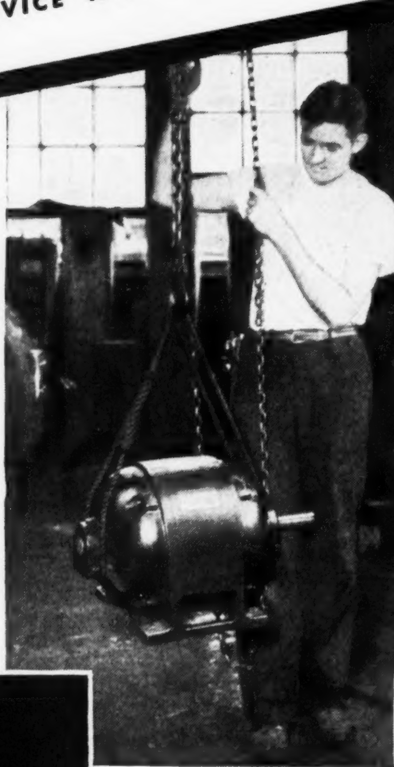
WITH THE

Extra Convenience Features

HELP YOU GET THE TRI/CLAD MOTOR INTO SERVICE FASTER . . . KEEP IT IN SERVICE WITH LESS ATTENTION.

Easy to Handle

1. They can be moved into position easily because of their light weight and compactness. The shape of the bearing housings and the location of end-shield fittings make it easy to handle Tri-Clad motors with slings. In addition, they are sturdily built and do not have to be coddled.



Quickly Mounted or Altered

2. Their feet are machined accurately and drilled for standard mounting bolts. The reversible stator puts the roomy conduit box on the most convenient side and the end shields can be rotated to any of four positions to meet mounting requirements.

f

3. A large,
duit box
working sp
quickly ren
Flexible lea
terminals, v
nently iden
connections
stainless-ste
nection pla
located on
side of the

Simple to Align

4. Accurate alignment, with the minimum of shimming, is afforded by their rigid, cast-iron frame construction, close machining tolerances, and accurate milling of feet. Pinions, pulleys, or couplings can be properly fitted because of close machining of the shaft extension and convenient shoulders on the shaft.

Convenient to Lubricate

5. Tri-Clad motors have a large oil or grease capacity. On sleeve-bearing motors, the oil-filler gage can be located on either side of the bearing housing. A spring cover on this gage permits quick checking of the oil level. On ball-bearing motors, a pressure-relief greasing system assures rapid and thorough greasing.

BUILT FOR PROTECTION FIRST . . . TO LAST

How Oxy-Acetylene Flame-Priming

can ease the load on Sand-Blasting Equipment

by preparing steel for better, faster, longer-lasting paint jobs . . .

OXY-ACETYLENE flame-priming of structural steel to remove loose scale, rust, and moisture before painting can, in many cases, completely eliminate sand-blasting. At the same time, this process does away with the necessity for chemical treatment of the steel prior to painting.

Flame-priming can be applied to steel or steel structures of practically any size. Irregularity of shape, recesses, rivets, or other "hard-to-get-at" parts offer no obstacle. This relatively new process is easy to learn, easy to use, and requires only a small amount of equipment.

Shown above is an operator using an Oxweld flame-priming blowpipe to prepare a large tank for a perfect paint job. The acetylene is from three manifolded Prest-O-Lite cylinders.

How It Works—To use flame-priming, a heating head is passed quite rapidly over the surface to be cleaned. The quick surface heat causes the loose scale to break away, and at the same time drives out surface moisture. The priming operation is closely followed by wire-brushing, and the paint is then applied while the metal is still warm and dry. As a result, the paint flows on faster, bonds tighter, and dries quicker. And because loose scale, rust, and surface moisture have been eliminated, subsequent paint flaking is avoided.

and Linde can help you use it!

If you would like to know more about flame-priming, get in touch with Linde! Whether it's welding, cutting, flame-hardening, flame-softening, descaling, or hard-facing—if it is a "flame" process—*it pays to ask Linde!*

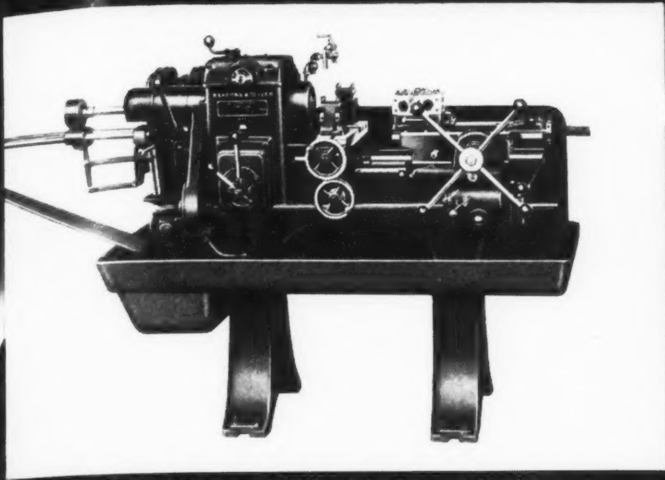
THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

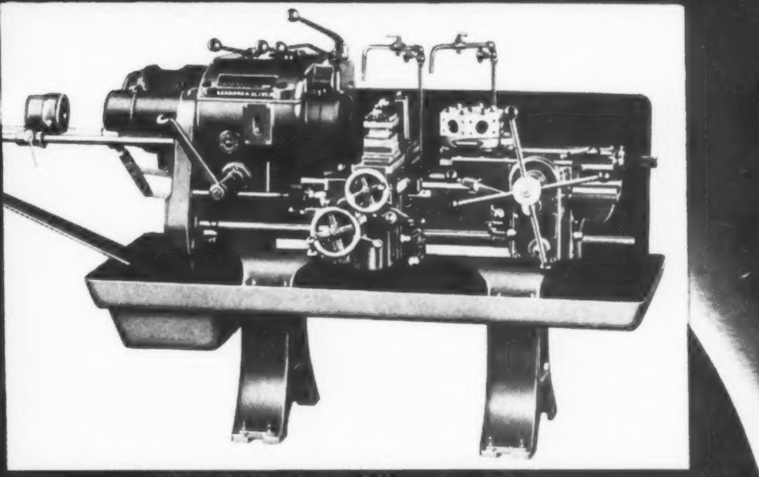
General Office: New York, N. Y. UCC Offices in Principal Cities
In Canada: Dominion Oxygen Company, Limited, Toronto

With standard welding heads, you can use your flame-priming equipment for heavy welding, and for straightening, forming, and other heating operations.

LINDE OXYGEN . . . PREST-O-LITE ACETYLENE . . . UNION CARBIDE
OXWELD, PUROX, PREST-O-WELD APPARATUS . . . OXWELD SUPPLIES

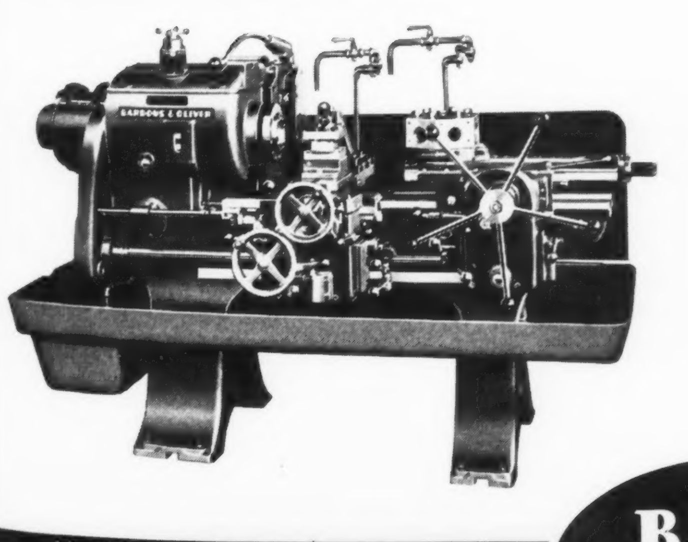


No. 2 Geared Electric Turret Lathe

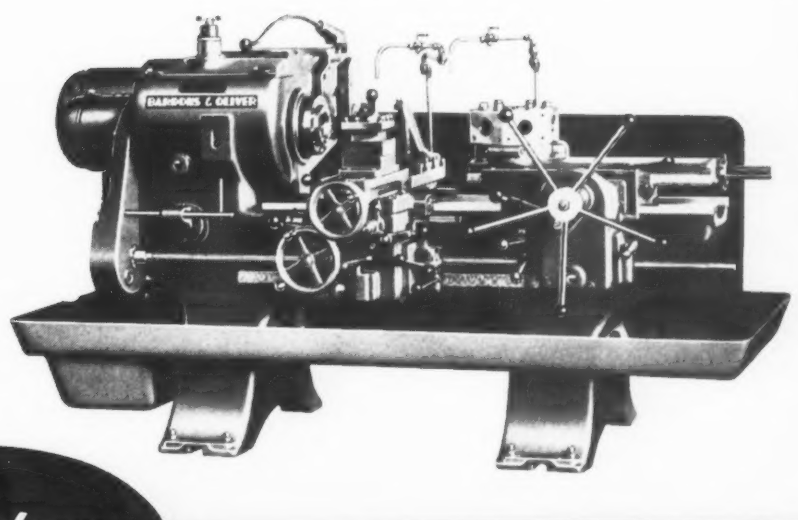


No. 3 Universal Turret Lathe

INCREASED PRODUCTIVE CAPACITY AND GREATER PROFIT POTENTIALITIES



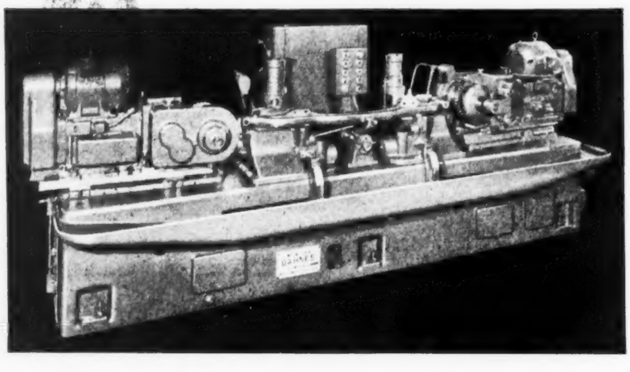
No. 5 Universal Turret Lathe



No. 7 Universal Turret Lathe

Bardons and Oliver

PROPER STUDY OF MILLING PROBLEM RESULTS IN DOUBLED PRODUCTION — GREATER ACCURACY



Machine in Brief

Horizontal machine with two standard self-contained hydraulic units, utilizing arbor milling cutters, to machine king-pin bosses simultaneously. Flexibility of unit design allows for relocation in case of future changes in axle design. Machine cycle is controlled with pushbuttons.

An unskilled operator, after a few minute's instructions, is producing approximately one axle per minute.

PERHAPS your production demands can be met with fewer machines. Perhaps that battery of *duplicate* standard machines isn't such a smart investment after all. Perhaps a proper analysis of your part, together with your production requirements and processing methods will result in a machine as efficient and simple as this one . . . designed and built to mill king-pin bosses of truck axles.

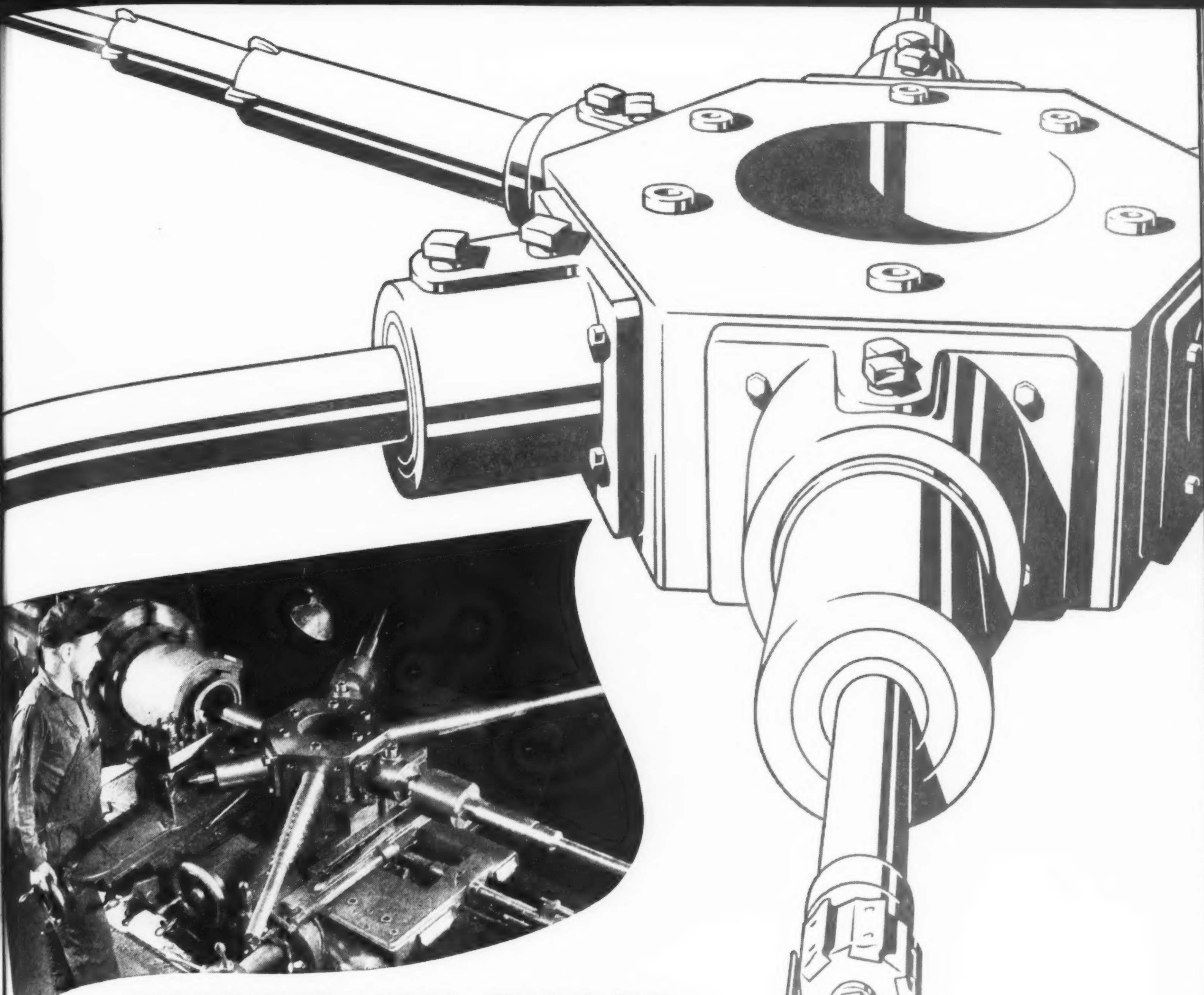
Let our experience be your catalog. For our job in this emergency is to draw from this past experience and design faster, simpler, and more accurate machines so that you can do more work with less equipment. An example of our work with a truck manufacturer is shown to the left. It's one of many of our installations and representative of our method of building special machine tools to *fit a specific job.*

Upon receipt of your part print and production requirements, we will be glad to furnish a preliminary design and estimate.

W. F. AND JOHN BARNES COMPANY

ROCKFORD • • • • ILLINOIS

DESIGNERS AND BUILDERS OF DRILLING—BORING—TAPPING—MILLING AND HONING MACHINES TO SUIT YOUR PARTS — YOUR PRODUCTION



WATCH FOR THOSE "*Choke Points*" IN PRODUCTION

Now that the pace of production is faster, those "choke points" show up more clearly than ever. Plan now to do something about them! If your old equipment can't keep pace today, it will be still more penalizing in the days that lie ahead.

If it's metal turning, your production can be accelerated by one of the new Gisholts. So rapidly have improvements taken place in Gisholt Turret Lathes that they are increasing production as much as 50% over the machines of a few years ago. That increased speed and accuracy will be an important factor in your future profits.

For more than a half-century, Gisholt developments have been coming in a steady procession, each one bringing simpler operation, greater speed, and lower cost. It pays to keep up with them!

Look ahead . . . keep ahead . . . with Gisholt improvements in metal turning

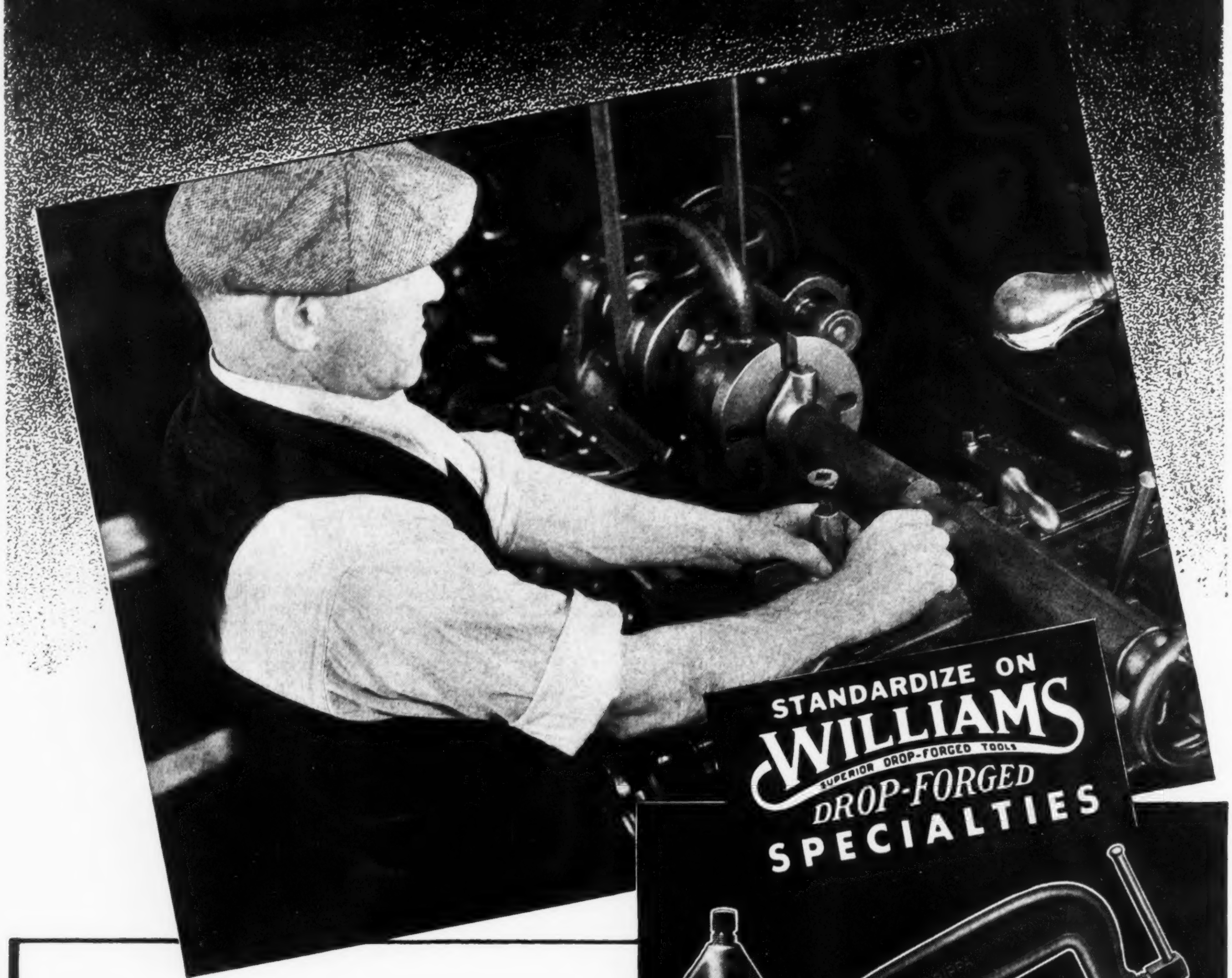
GISHOLT MACHINE COMPANY

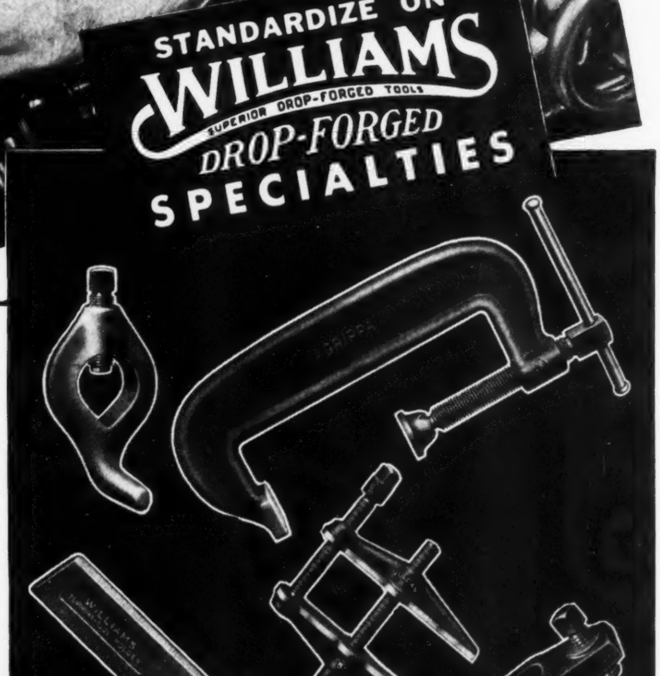
1209 EAST WASHINGTON AVENUE • MADISON, WISCONSIN

GISHOLT

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES

LABOR COSTS ARE LOWER WITH GOOD TOOLS



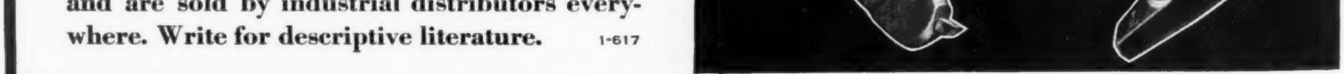


● The modern way to reduce labor costs is to make your skilled workmen *more productive* by supplying them with better tools.

For more than half a century, Williams has been making fine tools for industry—tools that not only enable the operator to produce more, but inspire him to better workmanship. And that means fewer rejects, less material waste.

All Williams' products are fully guaranteed and are sold by industrial distributors everywhere. Write for descriptive literature. 1-617

J. H. WILLIAMS & CO. HEADQUARTERS FOR 225 LAFAYETTE ST., NEW YORK



R. K. LeBLOND MACHINE TOOL CO. KNOWS CLEVELAND MODEL 'A'

Single Spindle

AUTOMATICS SPEED PRODUCTION OF SMALL LOTS AND SHORT RUNS

● Time saving is even more important to machine tool builders than to many other manufacturers whose production is under less pressure from all sides, and the choice of Cleveland *Single Spindle* Automatics by LeBlond is made as usual on the hard-boiled basis of comparative production costs. Their *own* exacting standards of precision limits of accuracy and speed of production must be supported by the machine tools they *buy*, and LeBlond has relied upon Cleveland Automatics for many years past. Some of the Clevelands in this plant have seen continuous service for more than two decades, and this newest 5¾" Model A vastly increases production capacity over that of its predecessors.

Gauging, drilling, forming, boring, turning, reaming and cutting off are the operations required for making a drive shaft gear from SAE 3140 bar stock, in lots of 40 pieces. • Gauging, forming except ends, turning two diameters, drilling and forming O.D. are the operations in making a cluster gear of SAE 3140 bar stock in lots of 50 to 120 pieces. • An intershaft gear made from SAE 3140 bar stock is produced in lots of 125 pieces—which by the former method required *one-third* more time. Operations: gauging, drilling, forming, boring for grind and finish counterboring 3¹¹⁄₁₆" deep, cutting off.

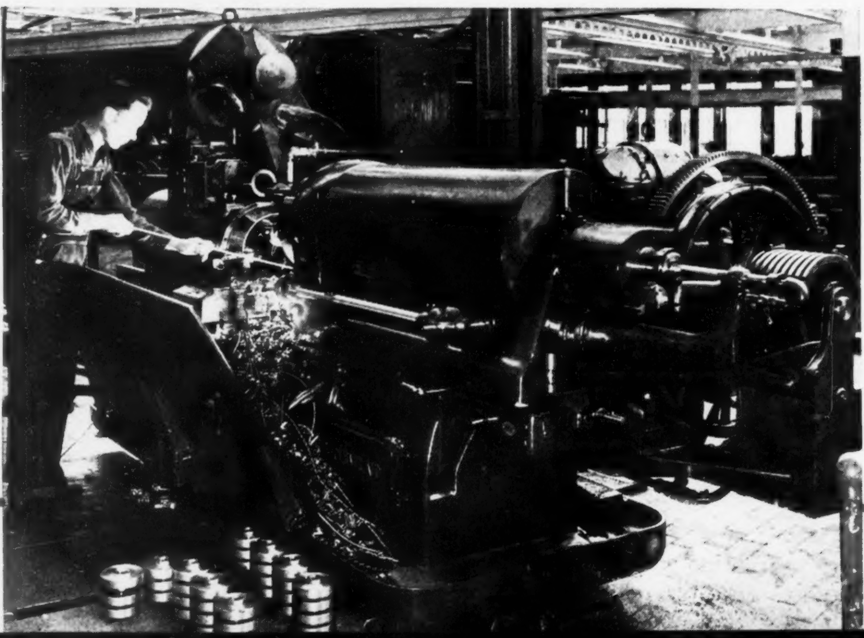
On small lots and short runs the larger size Cleveland Automatics offer unique advantages, not the least of which is ready accessibility for adjustment and quick tooling up. Powerful and fast, a Cleveland may have profit potentials for your plant in production routines where you believed you had exhausted the possibilities of further economies. A descriptive bulletin will be sent on request.

THE CLEVELAND AUTOMATIC MACHINE COMPANY

2269 ASHLAND ROAD • CLEVELAND, OHIO

Sales Offices: NEWARK—15 Washington Street • DETROIT—2842 Grand Boulevard
CHICAGO—565 West Washington Street • CINCINNATI—507 American Building

Cleveland's 4-speed motor drive, the variable tool feed and universal camming arrangement, may be seen here as applied to the 5¾" Single Spindle Automatic.



Flame-Cut Steel Plate *Quickly!*

WITH THE

PORTABLE

AIRCO

No. 10

RADIAGRAPH

Lower costs for cutting steel plate and sheet is your reward when using the 41 lb. motor-driven Airco No. 10 Radiagraph. With this oxyacetylene cutting machine you can do the job quickly, easily. It automatically cuts square or bevelled edges on circles from 3 inches to 85 inches in diameter . . . and it will make straight cuts of any length.

The Radiagraph is supplied complete with torch, tip and one track for a 60 inch long straight line cut. It is available for operation on either a.c. or d.c. For more detailed information, please write to any Airco sales office.

Air Reduction

General Offices: **60 EAST 42nd ST., NEW YORK, N. Y.**

DISTRICT OFFICES IN PRINCIPAL CITIES

AIRCO WILSON

Anything and Everything for **GAS WELDING or CUTTING and ARC WELDING**

Vacation this Year?

Though our national emergency is shortening and even cancelling many vacations this year, we hope you'll be able to slip away for a few days at least. While you're gone, your department can rely on Ryerson for the best steel-service that present-day circumstances will permit. In times like these, we are naturally out of many sizes but we still have a fair stock and service continues without interruption. So make the best of your days off . . . Relax! Build yourself up for the hard winter months ahead. Ryerson will help hold the fort.

Jos. T. Ryerson & Son, Inc. Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City

You know what you want from your cutting tools. Here's what users are getting from molybdenum high speed steels, in comparison with the tungsten types.

Equivalent cutting properties   Greater toughness   Lower cost

These are facts — with nine years' experience in thousands of shops to back them up. Check cost and performance records with any user you like. See your supplier for the proper analysis and heat treatment for your requirements.

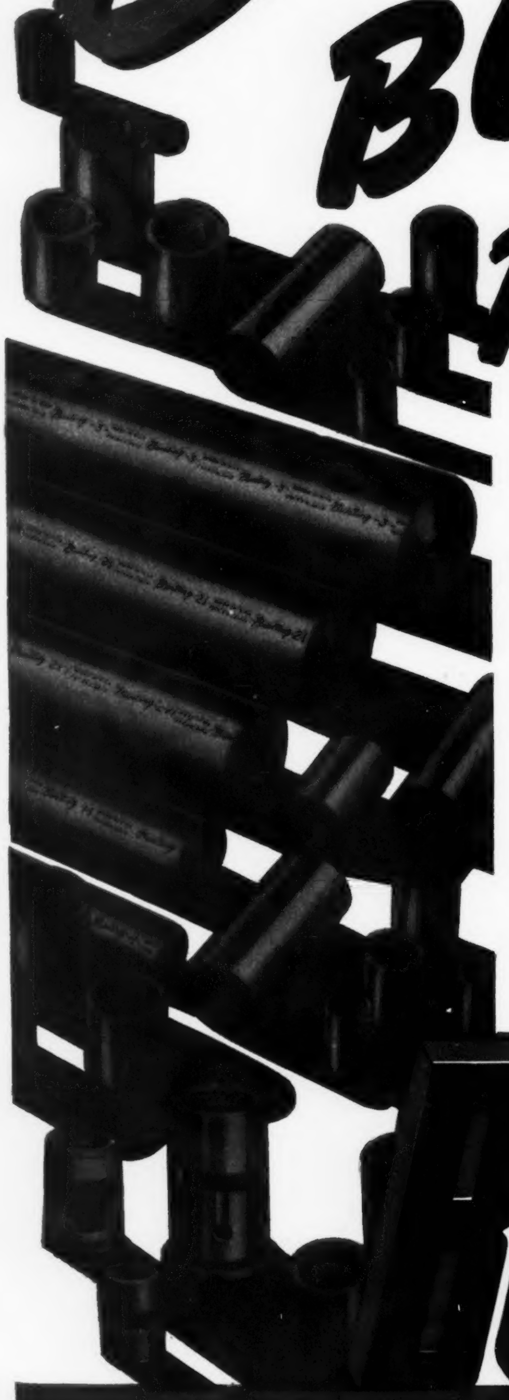
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTED OR CANNED · FERROMOLYBDENUM · CALCIUM MOLYBDATE

MOLY

Climax Molybdenum Company
500 Fifth Avenue · New York City

Engineer to BUNTING READY TO SHIP..

YOUR BEARING PROBLEM...



Manufacturers of machine tools and industrial machinery for years have been engineering to Bunting Bronze Standardized Bearings to improve performance, simplify production and service. Leading wholesalers and Bunting warehouses all over America maintain large stocks of these bearings in hundreds of sizes.

Because they are instantly available and fit all usual applications, these Precision-type Bunting Standardized Bearings are keeping machines running which otherwise would be idle, equipping machines which otherwise would be unfinished. They also can be made to meet many of the unusual bearing requirements by slight alterations.

Bunting also maintains large stocks of Standardized Bronze Bearings for every size and make of electric motor requiring sleeve-type bearings. These are ready for assembly, being completely finished to original designs and dimensional specifications.

Precision Bearing Bronze Bars, machined I. D., O. D. and ends, are available in hundreds of stock sizes.

Use the coupon or write for catalog.

BUNTING

Standardized Bearings .READY TO USE

The metal used for Bunting Standardized Bearings is Bunting No. 72 (SAE 660), the alloy specified for years by the majority of machinery manufacturers.

...WE HELP YOU SOLVE IT

No matter how unusual the bearing requirement may be, it can be met by a Bunting Bronze Standardized Bearing in combination with proper lubricating methods and other details specially engineered for the application.

Bunting engineers will show you how to make Bunting Bronze Standardized Bearings wholly satisfactory in your applications. Advice, blue prints, technical data are freely and promptly supplied for lubrication, relationship of running clearances to rotative speeds, press fitting, oil and dust sealing, and all other details of a successful bearing installation.

This service costs you nothing. State your bearing problem. We will help you solve it with bearings which can be obtained promptly from wholesalers and Bunting warehouses everywhere ... The Bunting Brass & Bronze Company, Toledo, Ohio. Warehouses in All Principal Cities.

Properly engineered oil grooves are readily machined into Bunting Bronze Standardized Bearings, thus assuring perfect lubrication. Typical standard examples a e shown.

Bunting

- BRONZE BUSHINGS • BEARINGS
- PRECISION BRONZE BARS
- BABBITT METALS

THE BUNTING BRASS & BRONZE COMPANY
Toledo, Ohio Dept. 17

Please send your free catalog of Bunting Standardized Bearings.

FIRM NAME ____________

ADDRESS ____________

CITY ____________ STATE ____________

YOUR NAME ____________

READ WHAT SCHOOL HEADS SAY

. . . Simple and easy to read. Contains useful information which commends it to technical men, semi-technical men, and men in the shops who want to improve their ability to make the best use of tools.

Prof. Bradley Stoughton
Dept. of Metallurgical Engineering
Lehigh University

. . . Valuable textbook for apprentices and journeymen, and an equally valuable handbook for tool designers and others concerned with the use of tool steel.

J. B. Chalmers
Director of Training School
The Yale & Towne Mfg. Co.

. . . have read and re-read the book. Became absorbed in finding out and learning so many things I never knew before. Chapter 17 on quenching is worth the price of the book . . . will need 45 copies for classroom use.

F. E. Laverty
Worcester Boys' Trade School, Worcester, Mass.

THE CARPENTER STEEL COMPANY
105 Bern Street, Reading, Pa.

Gentlemen: Please send me a copy of your 316 page handbook on tool steel selection and heat treatment — "Tool Steel Simplified". I enclose \$1.00. Send copy postpaid.

Name__________ Title__________
(Please Print)

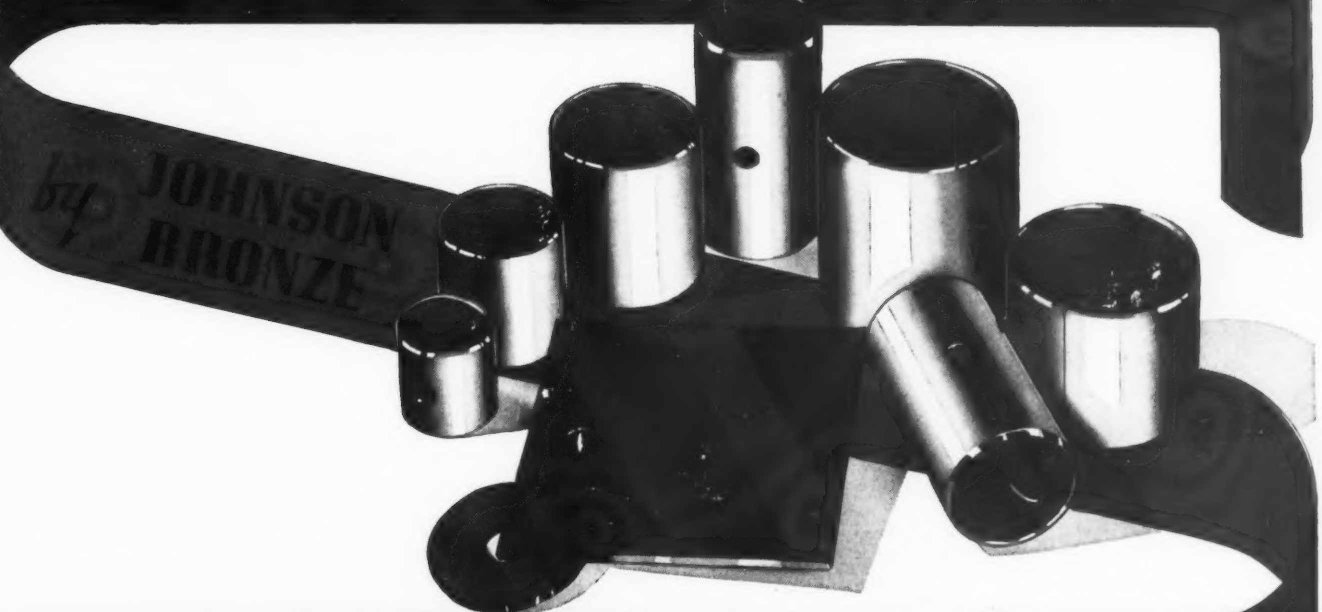
Firm__________
(Firm Name Must Be Given)

Address__________

City__________ State__________

Pre-Cast Bearing

Bronze on Steel



The Strength of STEEL
The Bearing Qualities of BRONZE

Write for this attractive folder for complete information on *Pre-Cast Bearing* BRONZE ON STEEL.

Examine a section of *Pre-Cast Bearing* BRONZE ON STEEL closely. Note how permanently the bronze is bonded to the steel.

Pre-Cast Bearing BRONZE ON STEEL was developed to meet the present day requirements of manufacturers in every type of industry. By combining the bearing qualities of bronze with the strength of steel, we enable you to increase speeds and loads . . . to gain longer life and smoother operation . . . greater resistance to shock and to wear.

Pre-Cast Bearing BRONZE ON STEEL is a thin wall, laminated type of bearing. A high quality bronze alloy, in powder form, is permanently bonded to strip steel. The fabricating process is essentially a series of stamping and forming operations. This provides a low unit cost with accuracy and precision.

While *Pre-Cast Bearing* BRONZE ON STEEL was developed primarily for sleeve bearings, it has already found many other important applications in industry. It is an ideal metal for stampings, washers or other flat pieces. Available either in rolls . . . up to 400 feet in length . . . or as finished parts, made to your specifications.

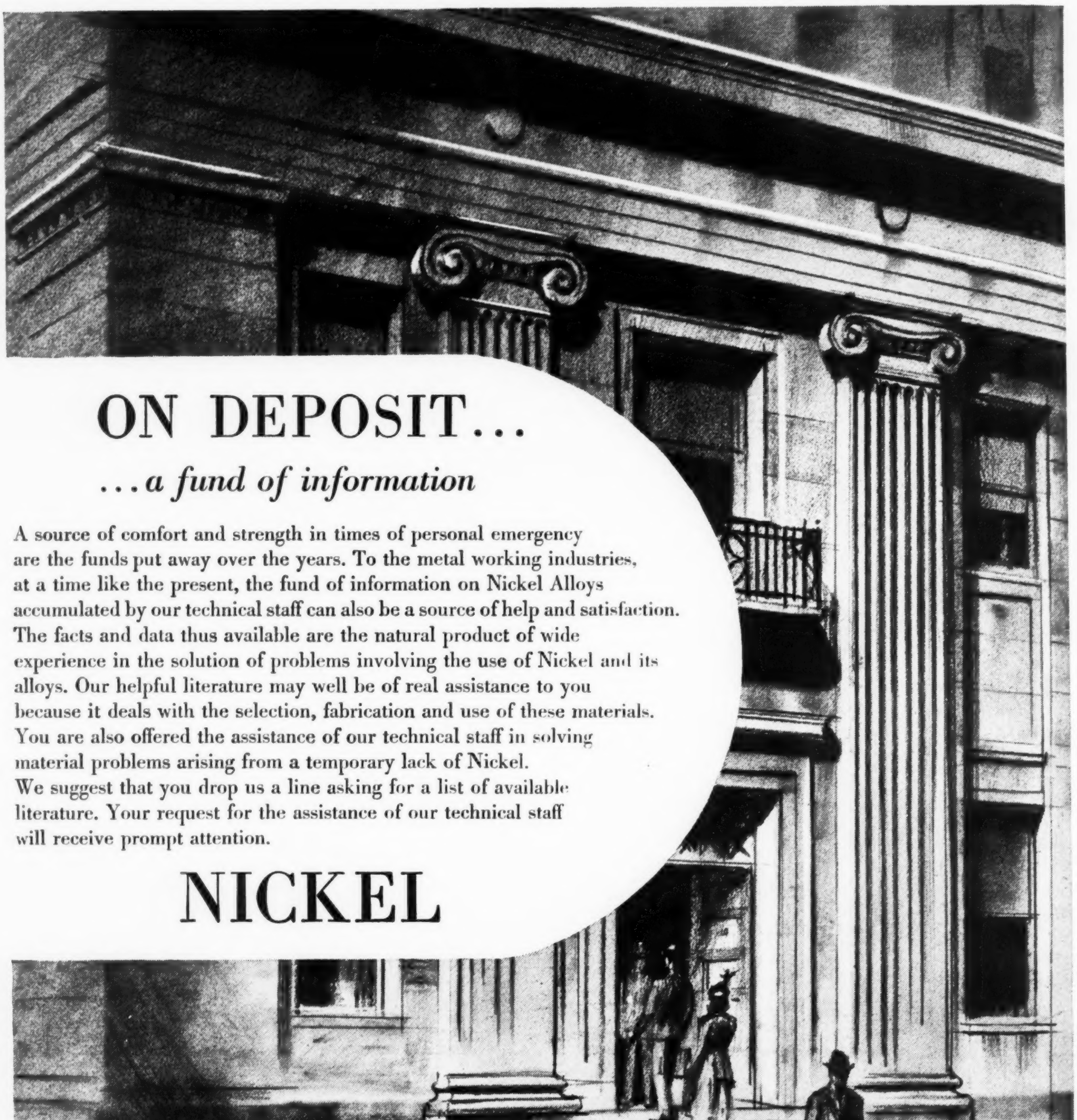
Why not investigate the possibilities of *Pre-Cast Bearing* BRONZE ON STEEL in your product? Complete information is available upon request . . . FREE.

The most complete SLEEVE BEARING SERVICE in the world

JOHNSON BRONZE COMPANY

Sleeve BEARING HEADQUARTERS

520 SOUTH MILL STREET • NEW CASTLE, PA.



ON DEPOSIT...

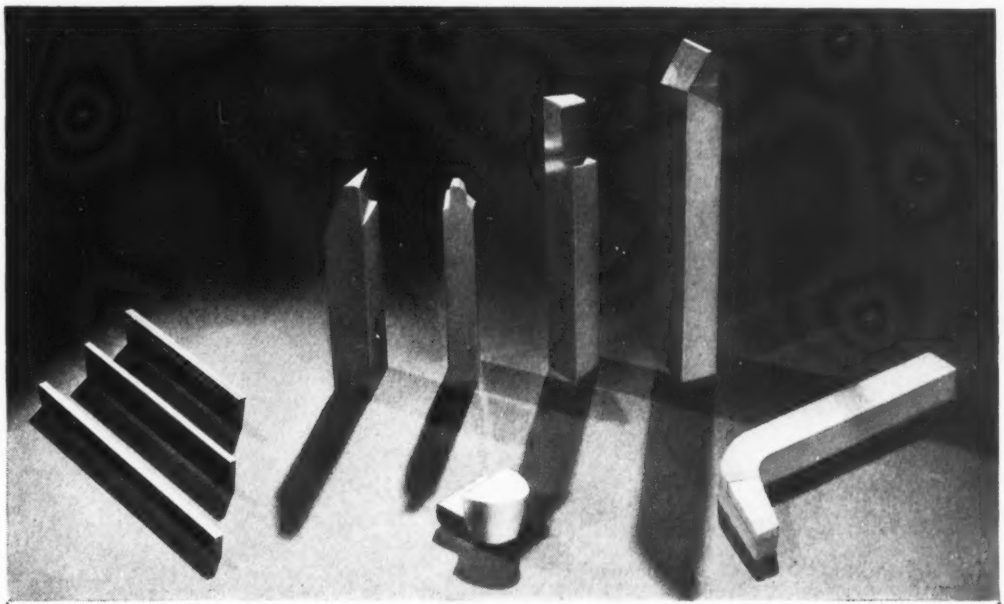
...a fund of information

A source of comfort and strength in times of personal emergency are the funds put away over the years. To the metal working industries, at a time like the present, the fund of information on Nickel Alloys accumulated by our technical staff can also be a source of help and satisfaction. The facts and data thus available are the natural product of wide experience in the solution of problems involving the use of Nickel and its alloys. Our helpful literature may well be of real assistance to you because it deals with the selection, fabrication and use of these materials. You are also offered the assistance of our technical staff in solving material problems arising from a temporary lack of Nickel. We suggest that you drop us a line asking for a list of available literature. Your request for the assistance of our technical staff will receive prompt attention.

NICKEL

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

HAYNES STELLITE TOOLS For High Production at Low Cost per Piece Machined



Special Tools Available on Order

Shown above are a few typical Haynes Stellite special turning and grooving tools, a welded tip tool, and a tool tip. Special tools for practically every machining operation are regularly supplied, cast and finish ground to users' specifications. These include milling cutter and reamer blades, brazed-in blade shell end mills, spot facers, counterbores, reamers, and a variety of form tools. Details upon request.

Take full advantage of the high cutting quality of the many available forms of Haynes Stellite cutting tools. These uniform, dependable tools increase production and at the same time assure low cost per piece machined. Haynes Stellite alloy tools are efficiently and economically used for machining practically all machinable materials except chilled cast iron and manganese steel.

Standard Tools for Immediate Delivery

Standard Haynes Stellite tool bits are available in a variety of sizes—both flat and square—ready for immediate delivery. These bits are supplied finish ground ready for use in standard tool holders. They will help you reduce your tool inventory because they can be easily converted to the special profiles required for various operations.

For jobs on which the use of solid bits is not practicable, you can obtain immediate delivery on standard welded tip tools in a wide variety of sizes and shapes.

Write or phone the district office nearest you for complete information on standard and special Haynes Stellite tools.

HAYNES STELLITE TRADE MARK

Red-hard, wear-resisting alloys of cobalt, chromium and tungsten

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

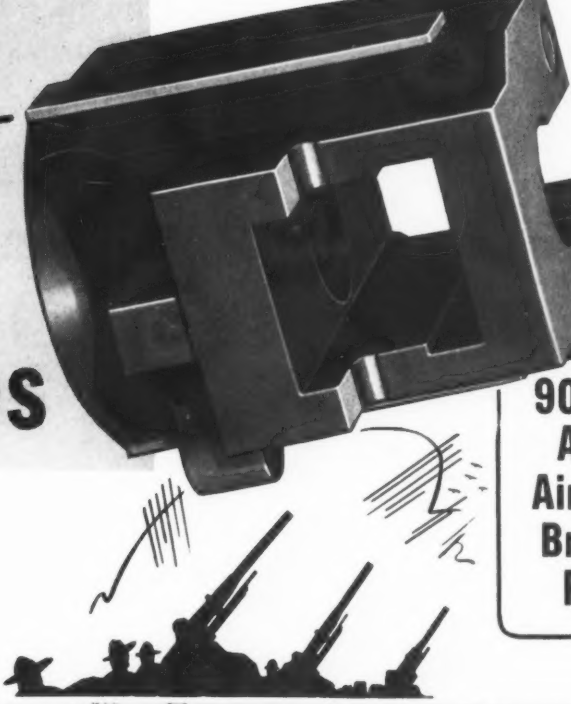
New York, N. Y. UCC Kokomo, Indiana

Chicago—Cleveland—Detroit—Houston—Los Angeles—San Francisco—Tulsa

• HIGH-PRODUCTION METAL-CUTTING TOOLS •

"Haynes Stellite" is a registered trade-mark of Haynes Stellite Company

Here's one of the toughest
Munitions Broaching Jobs

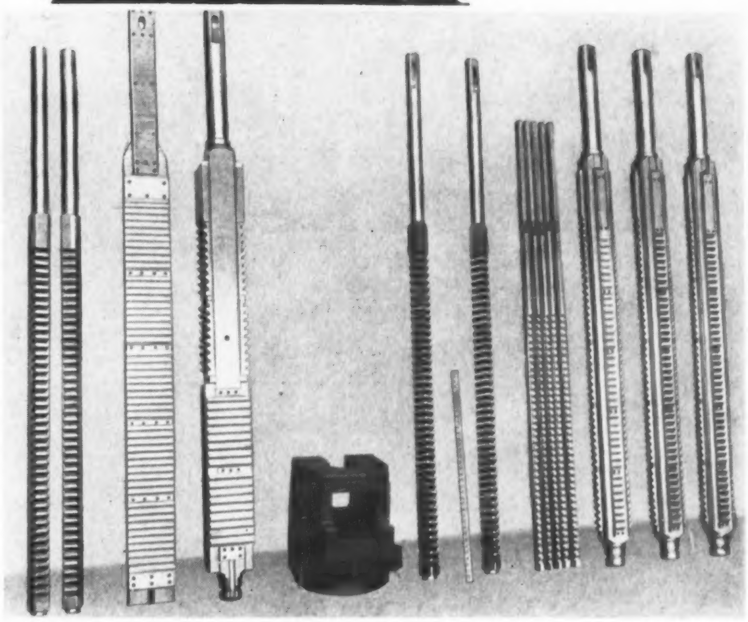


90 mm. Anti-Aircraft Breech Ring

MADE EASIER WITH

Stuart's Thred-Kut

PAT D U S PATENT OFFICE



THIS is another example of a difficult metal working problem made easier with Stuart's Thred-Kut. These 1,000 lb. breech rings are broached on the largest broaching set-up ever developed by Lapoint Machine Tool Co. It was natural to put Stuart's Thred-Kut on the job because of its proved performance and wide use in armories, arsenals, aircraft plants and other related industries where *nothing less than the best* cutting fluid can serve.

For tapping, threading, deep drilling, broaching, gear cutting and all alloy steel machining operations—use Stuart's Thred-Kut. You'll save time, money and headaches. Write . . . wire . . . phone for a trial drum today.

• *Above is shown the set of 14 broaches used to broach the 90 mm anti-aircraft gun breech ring. 28 cuts are taken to remove 230 cubic inches of material. One part of the square hole has a 1¼° taper. Squareness, size and taper are held to an accuracy of .0015″.*

Remember:

the cost of cutting fluids is measured by pennies — the cost of tools and production by dollars!

For All Cutting Fluid Problems

D. A. STUART OIL CO.

Chicago, U.S.A. • LIMITED • **Est. 1865**

Warehouses in All Principal Metal Working Centers

Southwark's new line of High Pressure Horizontal Triplex pumps has been thoroughly tested in actual service. For delivering large volumes of High Pressure water in conjunction with hydraulic press installations, these pumps are built in 12-, 15- and 18-in. stroke lengths. The three-plunger arrangement provides a 60 degree overlap in discharge impulses and tends to smooth out pump pulsations.

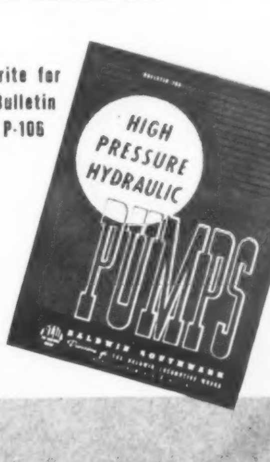
The 12-in. stroke pump discharge ranges from 23 gpm at 7,500 lb per sq in. to 170 gpm at 1,000 lb per sq in.; that of the 18-in. stroke unit from 88 gpm at 7,500 lb per sq in. to 685 gpm at 1,000 lb per sq in. Other capacities and corresponding pressures are available.

Where a smaller capacity pump is required, Southwark builds a line of Vertical Triplex pumps. Their capacities range from 2 to 100 gpm at pressures from 15,000 to 1,000 lb per sq in. respectively.

Bulletin P-106 contains a complete description of these pumps together with tables showing dimensions, capacities and power requirements. Write for your copy today.

Baldwin Southwark Division, The Baldwin Locomotive Works, Philadelphia; Pacific Coast Representative, The Pelton Water Wheel Co., San Francisco.

Write for Bulletin P-106



Baldwin Southwark

DIVISION OF
THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA

BLW
THE BALDWIN GROUP

ACCURACY

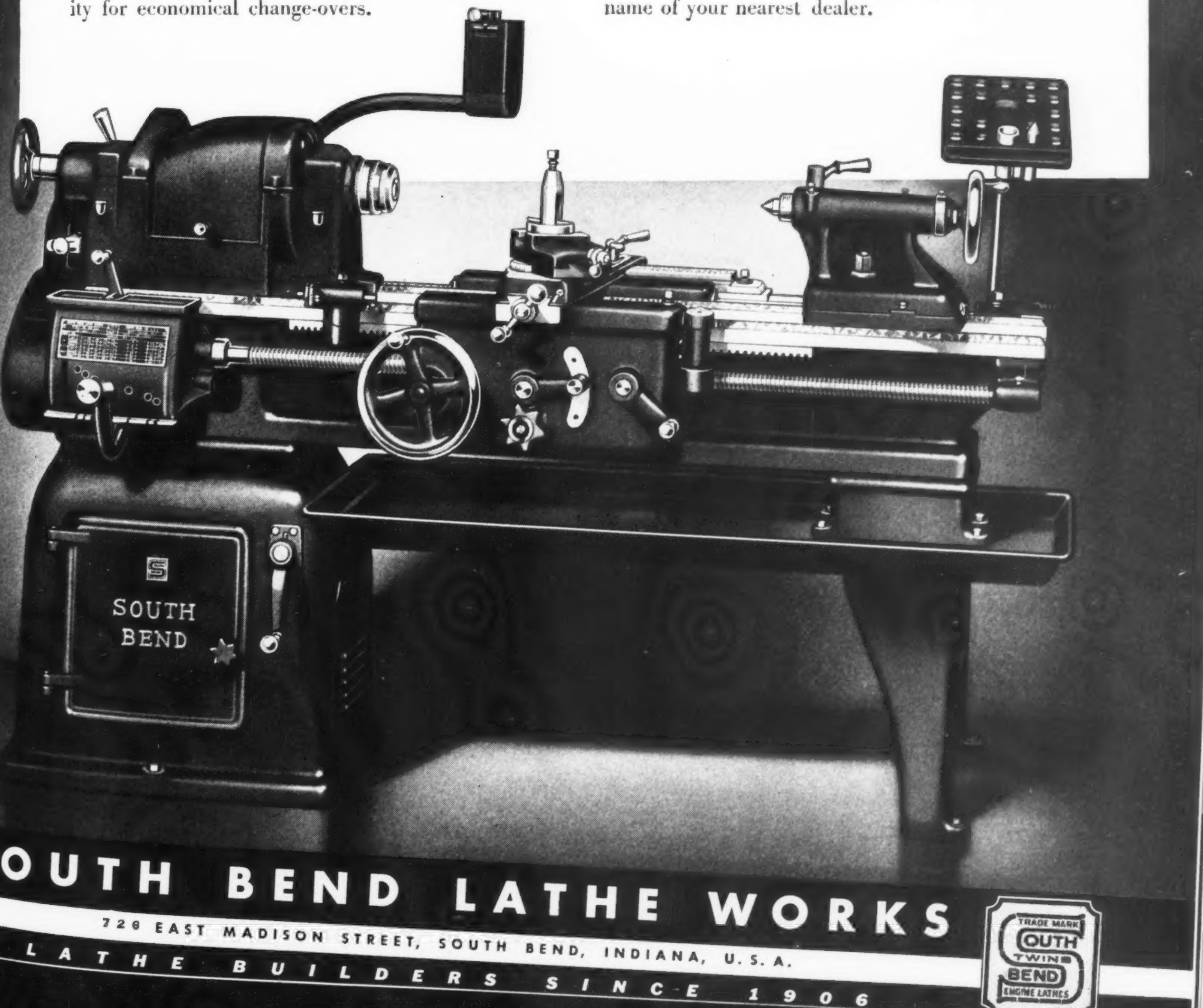
FOR THE FIRST LINE OF DEFENSE

LOOKING at today's whirring defense program, the first picture is that of speed—and tremendous mass production. But behind every such picture there is one of the tool room—the *first* line of defense—where the tools and fixtures for the production line are designed and built. It is in this picture, where measurements are reckoned in split thousandths of an inch, that you will find South Bend Lathes.

Sound design, expert workmanship and quality materials give South Bend Lathes extreme accuracy for precision tool and gauge work—smooth power and speed for efficient production—time-saving versatility for economical change-overs.

It is for these reasons that South Bend Lathes are demanded in ever-increasing numbers by some of the nation's key industrial plants, and by the Army and Navy. The South Bend Lathe Works is prepared to meet the demand—and is meeting it every day—with the same quality, the same high standards which have been maintained through 34 years of fine lathe manufacture.

South Bend Lathes are made in five sizes: 9″, 10″, 13″, 14½″ and 16″ swing, 3′ to 12′ bed lengths, in Tool Room or Manufacturing types, countershaft or motor drive. Write for New Catalog 100A and the name of your nearest dealer.



SOUTH BEND LATHE WORKS

728 EAST MADISON STREET, SOUTH BEND, INDIANA, U.S.A.

LATHE BUILDERS SINCE 1906

TRADE MARK SOUTH TWIN BEND ENGINE LATHES

Of 8 Oils on Test . . .
this One Proved Best

THE ETTCO TOOL CO. of Brooklyn, N. Y., tested 8 different cutting oils to find the brand that would give them longest cutter life, highest spindle speed, finest finish, greatest output.

Of the 8 brands tested, one stood out . . . *TEXACO SULTEX CUTTING OIL.*

Texaco Sultex assures you of *all* of these benefits because it cools both the cutter and the work, thus preventing chip welding.

The outstanding performance that has made Texaco preferred in the fields listed in the panel has also made it preferred by prominent machine tool operators everywhere.

These Texaco users enjoy many benefits that can also be yours. A Texaco Engineer specializing in cutting coolants will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distributing plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

TUNE IN: "Treasury Hour—Millions for Defense." All-Star Radio Program, Every Wednesday Night, CBS. 9:00 E.D.T., 8:00 E.S.T.; 8:00 C.D.T., 7:00 C.S.T.; 6:00 M.S.T.; 5:00 P.S.T.

THEY PREFER TEXACO

★ More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

•

ETTCO-EMRICK Tapping Attachments, Multiple Tapping Heads and Tapping Machines *(left)* are precision made . . . *Texaco Sultex Cutting Oil* used throughout.

TEXACO REG. T.M.

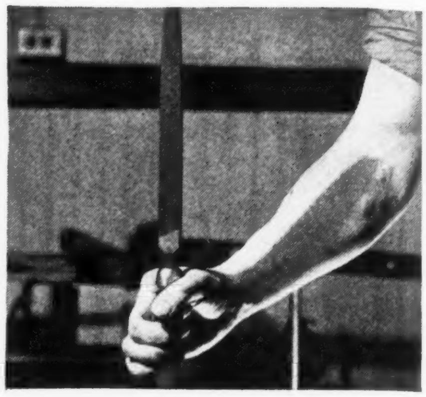
TEXACO Cutting and Soluble Oils
FOR THE METAL WORKING INDUSTRY

SOME HINTS ON . . .

FILES and FILING

The skilled mechanic needs little instruction in the use, care and choice of files for different jobs. But National Defense activity has brought into industry many promising though less experienced shop men who may be helped by these suggestions.

FREE REPRINTS OF THIS PAGE, for shop Bulletin Boards or similar use, will gladly be sent to any responsible person.



"THE tool is but an extension of the hand," say the philosophers. It can accomplish the things for which it was designed only through power and guidance supplied by the hand. The logic applies most aptly to files. Here are some hints on making files more efficient—more obedient to your command:

Use the correct file for the job. You wouldn't drive a spike with a tack hammer, shave with a bowie-knife, or cut cloth with sheep-shears. The good mechanic is equally exacting. For metals which are soft, yet ductile and tough—like brass and copper—he uses a Brass File, whose specially designed double-cut teeth remove these metals rapidly and with a minimum of clogging.

For rapid filing of aluminum, which is still softer, he uses a Type A Aluminum File—a file with a coarse, deep upcut and a fine, light overcut which removes metal rapidly and also prevents "channeling," "clogging" and "chattering." For lead, which is extra soft, he uses a Lead Float File. Lathe filing, with its special technique, calls for a Long Angle Lathe File. The long angle permits the file to cut very rapidly without clogging and to leave an extremely smooth finish.

Fig. 1

For keyways, slots and for narrow work and sharp angles he selects Pillar, Square, Three-square or Warding Files; Knife Files for extra-narrow places. For the infinite angles, curves, holes and slots encountered in model and die making, or for fine-instrument assembling and repairing, there is a multiplicity of shapes, sizes and cuts in small "precision" files commonly known as "Swiss Pattern." And so on. . . . There are, in fact, more than 3000 kinds, cuts and sizes of files in the Nicholson and Black Diamond lines—each having a special advantage over the others for a given job or purpose. "Know your files and get ahead," is good advice!

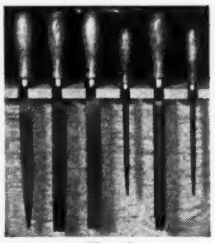


Fig. 2

Keep the file cutting. One of the easiest ways to ruin a file is to use too much pressure—or too little—in the stroke. Different materials, of course, require different touches; but, in general, just enough pressure should be applied to keep the file cutting at all times. If allowed to slide over the work, the teeth of the file rapidly become dull; and if they are "overloaded" by too much pressure, they are likely to chip or clog.

Place work at proper height for filing. Most work to be filed is held in a vise. For general filing, the vise should be about elbow height. If a great deal of heavy filing is to be done, it is well to have the work lower. If the work is of a fine and delicate nature, it should be raised near to the worker's eye level. For work which is apt to become damaged by pressure when held in a vise, it is well to provide a pair of "protectors"—blocks of zinc, copper, or other fairly soft metal for placing between the jaws and the work to be held (see Fig. 1).

Take care of your files. A file's life is greatly shortened by improper care as well as by improper use. Files should never be thrown into a drawer or tool box containing other tools or objects. They should never be laid on top of or stacked against each other. Such treatment ruins their keen cutting edges. Keep them separated—either standing with their tangs in a row of holes or hung on a rack by their handles (see Fig. 2). Keep them in a dry place so rust will not corrode their teeth points.

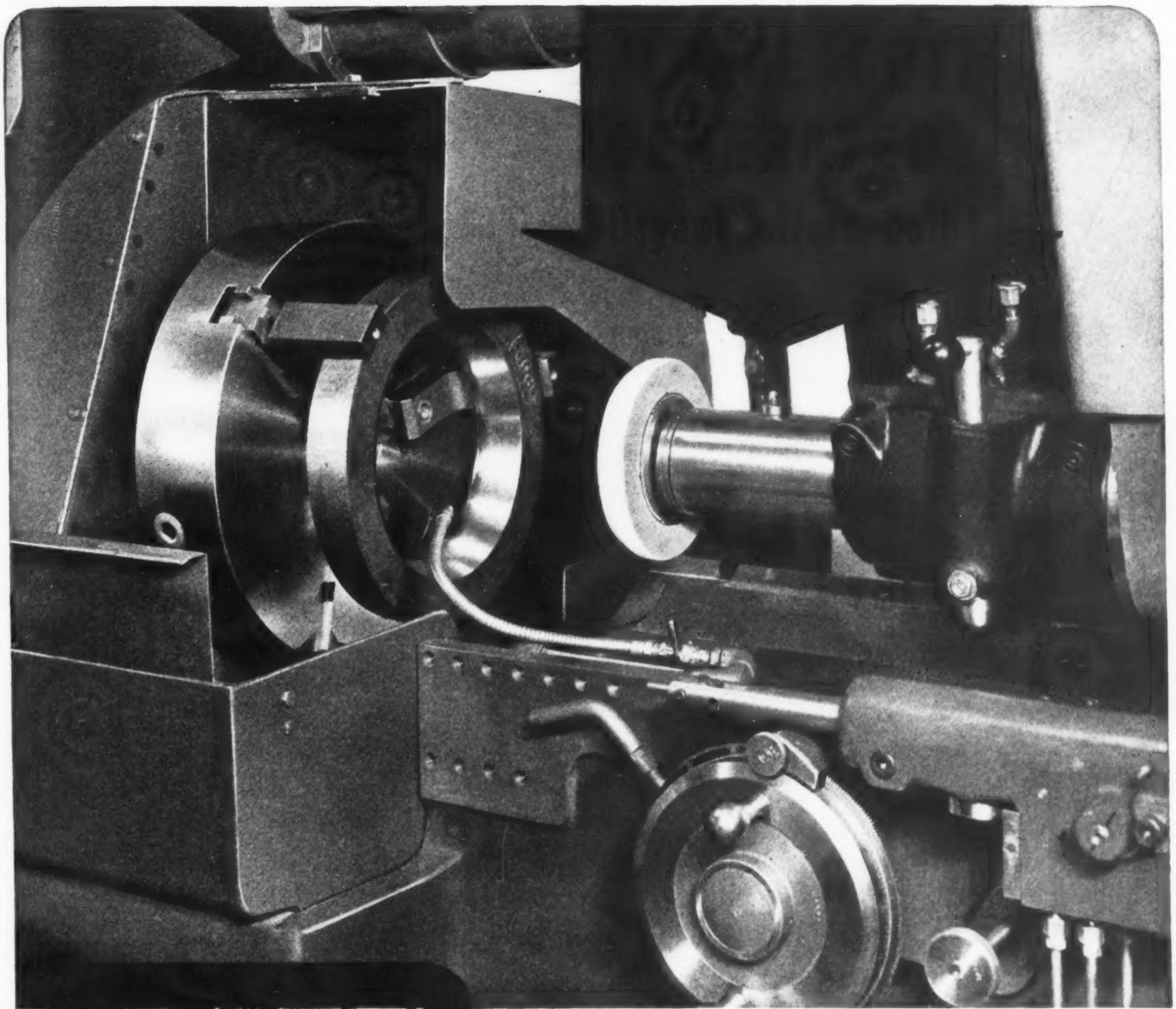
It is also of great importance to keep files clean of filings or "chips," which often collect between the teeth during use. After every few strokes the good mechanic taps the end of the file on the bench to loosen these "chips." And he always has on hand a File Card or Brush. The cutting edges of the file should be brushed frequently (see Fig. 3)—and always before putting the file away.

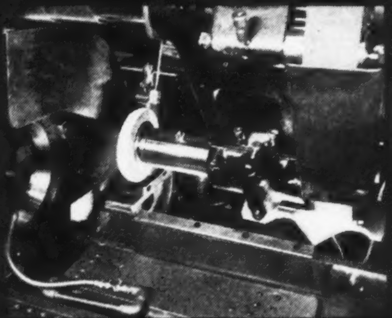
Fig. 3

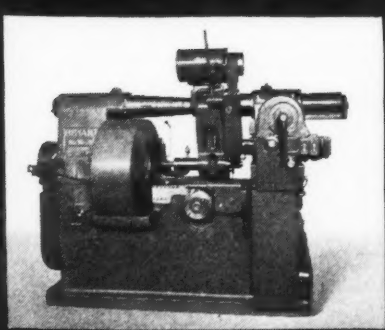
NICHOLSON FILE CO., Providence, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

LONG ANGLE LATHE FILE
Here is one of the many kinds of special-purpose files designed by Nicholson toward more efficient filing on specific types of work and materials. Long angle (of teeth) affords fast cutting and self-clearing; requires less pressure, and virtually eliminates pinning up and scratching. Safe (uncut) edges protect shoulders and the dog. Can also be used for bench filing of many materials — such as aluminum and compositions of brass and bronze. Available through mill-supply houses in either Nicholson or Black Diamond brand. Send for FREE TECHNICAL BULLETIN.

NICHOLSON FILES
FOR EVERY PURPOSE
NICHOLSON U.S.A.
MADE IN U. S. A.







DISCOVER

RIGHT R AND L LEFT

SIMPLICITY

AND

SAVINGS

Try R&L Tools! Discover their amazing simplicity, the ease with which they lend themselves to a great variety of set-ups, the speed with which they can be changed from one job to another—from right- to left-hand operation.

These R&L features give you a **three-way saving.** They save in **first cost** by replacing the many separate tools formerly required to do such a variety of jobs. Their multiple operation features save in **time** by reducing the number of set-ups. And they save in **maintenance** because of their simple, rugged construction.

Write for the R&L Booklet, showing interesting jobs that will give you ideas for adding to the productive capacity of your machines with R&L Tools.

R AND L TOOLS

1825 BRISTOL STREET

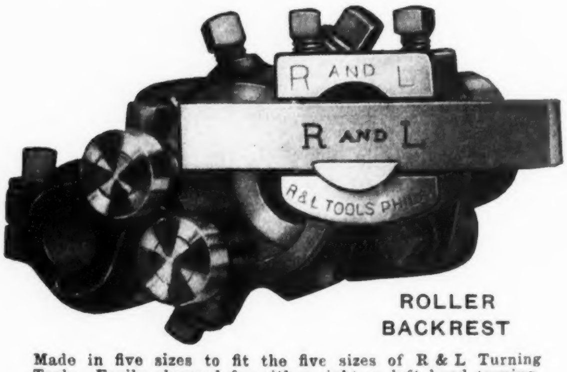
Nicetown, Philadelphia, Pa.

R & L TURNING TOOL

Shown set up for drilling, turning and burnishing. The Tantalum Carbide backrest may be removed and the new Roller Backrest, shown below, substituted.

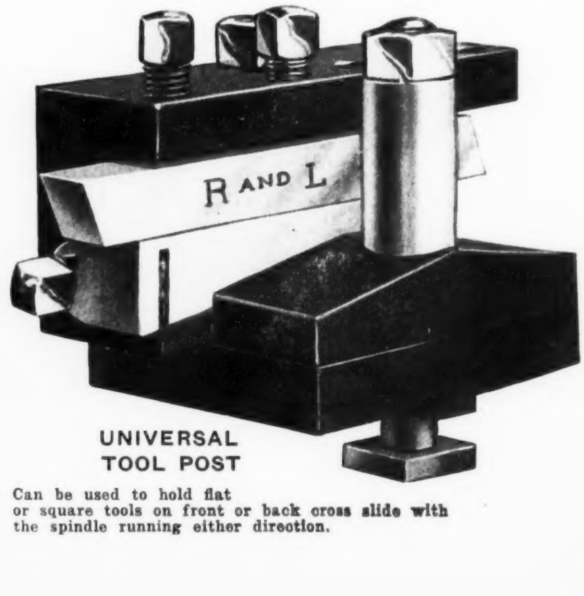
TAP AND DIE HOLDER

New design eliminates spring plungers and small screws. Engaging teeth separate fully — and instantly — when released, eliminating wear.



ROLLER BACKREST

Made in five sizes to fit the five sizes of R & L Turning Tools. Easily changed for either right or left hand turning.



UNIVERSAL TOOL POST

Can be used to hold flat or square tools on front or back cross slide with the spindle running either direction.

HELPING SOLVE INDUSTRY'S PRODUCTION PROBLEMS

RIFLING *now practical* by BROACHING!

"Illinois Tool" engineers develop complete tooling and equipment for broaching machine gun and rifle barrels

Years of **intensive research** by "Illinois Tool" **engineers have recently** resulted in the first **successful adaptation** of the broaching method to the rifling of machine gun and rifle barrels.

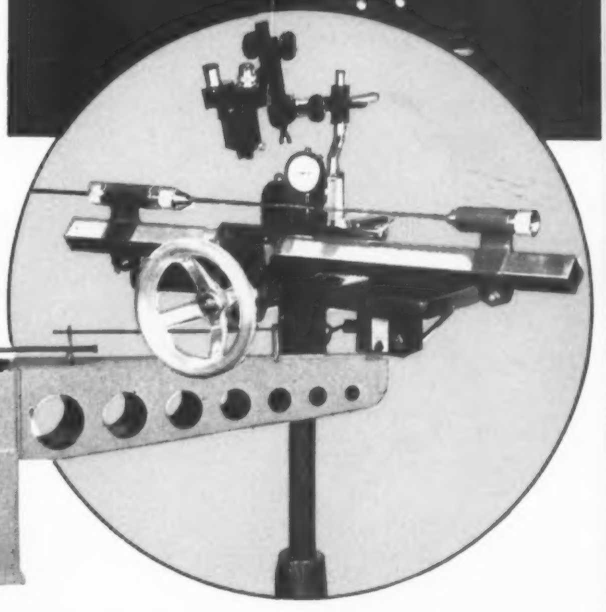
This important defense contribution brings the increased production, speed and accuracy of the broaching method to a field producing vital parts for our armament program.

All the elements for this new broaching system were designed and manufactured under the supervision of "Illinois Tool" engineers, including:

1. Broaches
2. Broaching machines
3. Broach sharpening machines
4. Broach inspection fixtures

The successful rifling of gun barrels by the broaching method is an outstanding example of "ILLINOIS" engineering research teamed with practical production experience, providing the solution to a difficult production problem.

"ILLINOIS" broach sharpening machine.



Close-up view of special "ILLINOIS" inspection fixture for rifling broaches.

View of special "ILLINOIS" broaching machine for 50 caliber machine gun barrels.

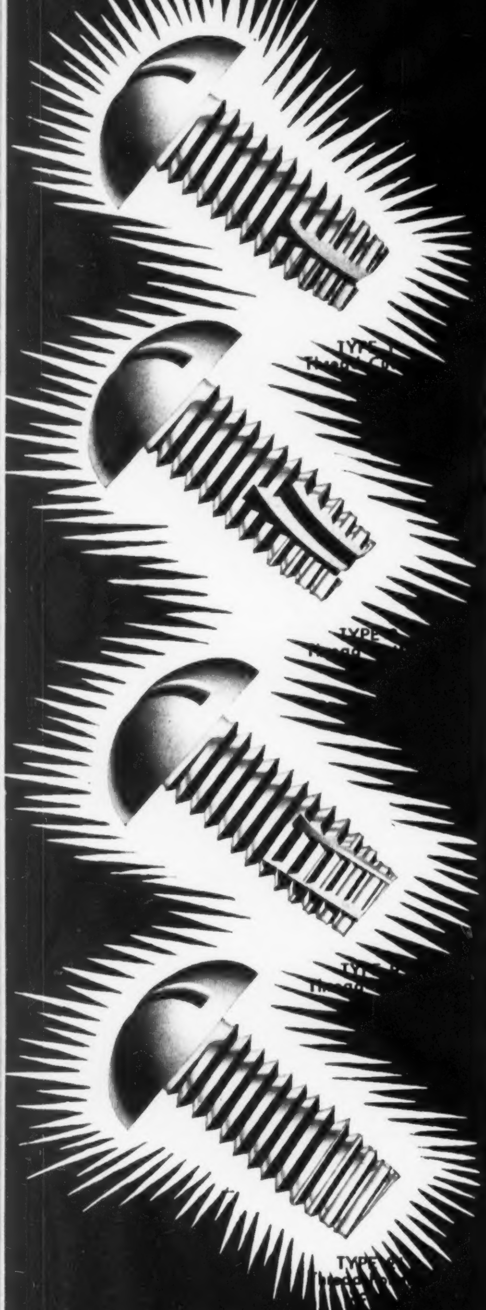
ILLINITE
HIGH SPEED PRODUCTION TOOLS

Milling Cutters • Ground Hobs • Broaches
Shaper Cutters • Ground Form Tools
Special Tools • Die Filing Machines
Gear Measuring Machines

ILLINOIS TOOL WORKS

MANUFACTURER
NORTH

Here's your chance to test
SHAKEPROOF *Thread-Cutting Screws!*



FREE
SAMPLE KIT
Mail coupon Today!

Be sure to get this handy sample kit of Shakeproof Thread-Cutting Screws. All four types in a wide variety of sizes and head styles are neatly packaged for quick, easy selection. Drive them yourself—see how they cut their own threads in materials of any thickness—see what strong, rugged fastenings they make!

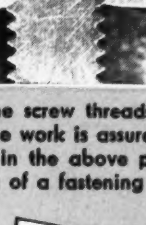
FOR PLASTICS, TOO!

Types 2 and 9 are specially designed for use in plastics. They eliminate the need for threaded inserts or separate tapping operations.

BETTER THREAD ENGAGEMENT PRODUCES STRONGER FASTENINGS!

Because Shakeproof Thread-Cutting Screws are made with standard machine screw threads, a maximum engagement with the work is assured. This fact is clearly illustrated in the above photo showing the cutaway section of a fastening made in thin metal.

SHAKEPROOF LOCK WASHER CO.
Distributor of Shakeproof Products
Manufactured by ILLINOIS TOOL WORKS
2501 North Keeler Avenue, Chicago, Illinois
Plants at Chicago and Elgin, Illinois
Canadian Plant: Canada Illinois Tools, Ltd., Toronto, Ontario
Foreign Licensee: Barber and Colman, Ltd., Brooklands, Manchester, England



ALL SHAKEPROOF SCREW PRODUCTS AVAILABLE WITH PHILLIPS RECESSED HEADS!

SHAKEPROOF LOCK WASHER CO.
2501 No. Keeler Ave., Chicago, Ill.

Gentlemen:
Rush us one of your free sample kits of Shakeproof Thread-Cutting Screws!

Firm Name ____________

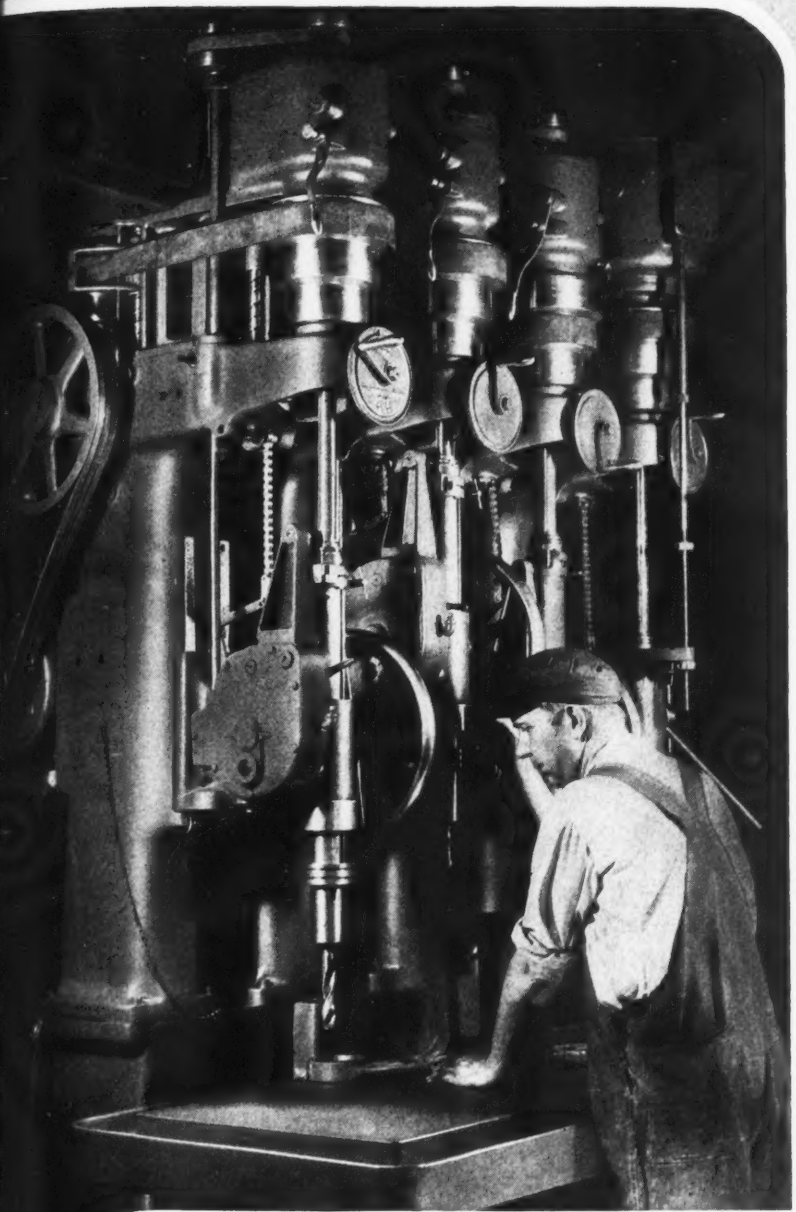
Address ____________

City ____________ State ____________

Signed by ____________ Title ____________

"Fastening
SHAKEPROOF
Headquarters"

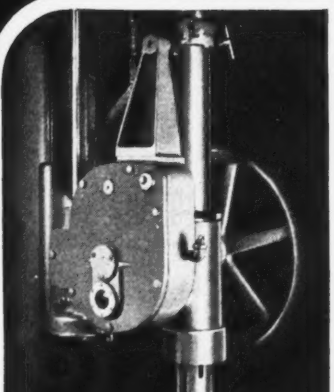
FOR THE *HEAVIER* TYPE SENSITIVE DRILLING



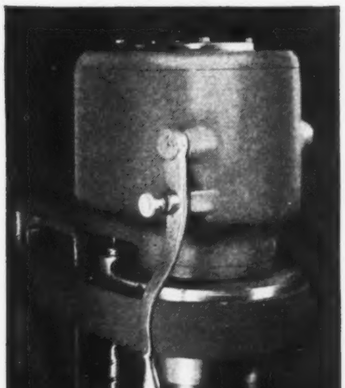
ANOTHER Footburt Full Range Machine for drilling holes up to 1¼″ in cast iron. Attachments including power feed, back gear unit, tapping unit and coolant outfit make these machines adaptable for many drilling, tapping, reaming and counterboring requirements. They are built to stand up under the new high production schedules demanded by defense programs.

Early deliveries are still possible. Wire or write for full information.

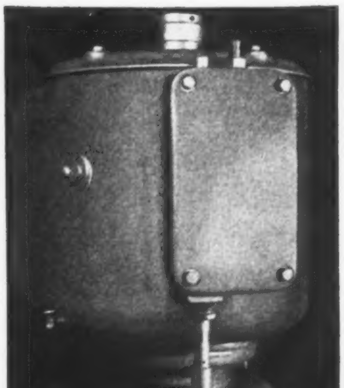
THE FOOTE-BURT COMPANY
CLEVELAND, OHIO
Detroit Office: 4-151 General Motors Building



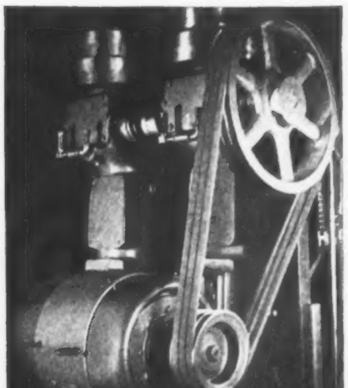
POWER FEED



BACK GEAR UNIT



TAPPING ATTACHMENT



DOUBLE SPINDLE MOTOR DRIVE

FOOTBURT *Sensitive* DRILLING MACHINES

99 99/100 %

PERFORMANCE

IN 11,000 HOURS OF OPERATION

What's your average on Airplane Valve Tappet Guides?

CONE
AUTOMATIC MACHINE CO., INC.
WINDSOR, VERMONT, U. S. A.

A Four-Spindle Conomatic produced 38 of these airplane valve tappet guides per hour over a period of 11,000 hours. During this period the machine was down only 12.7 hours for minor adjustments.

Gulf SELLS lubrication results!

Gulf Engineering Service is helping every industry improve equipment performance and speed up production.

OPERATING officials in scores of busy plants report immediate results by following Gulf Engineering Recommendations — results which can actually be measured in terms of better machine performance and increased production.

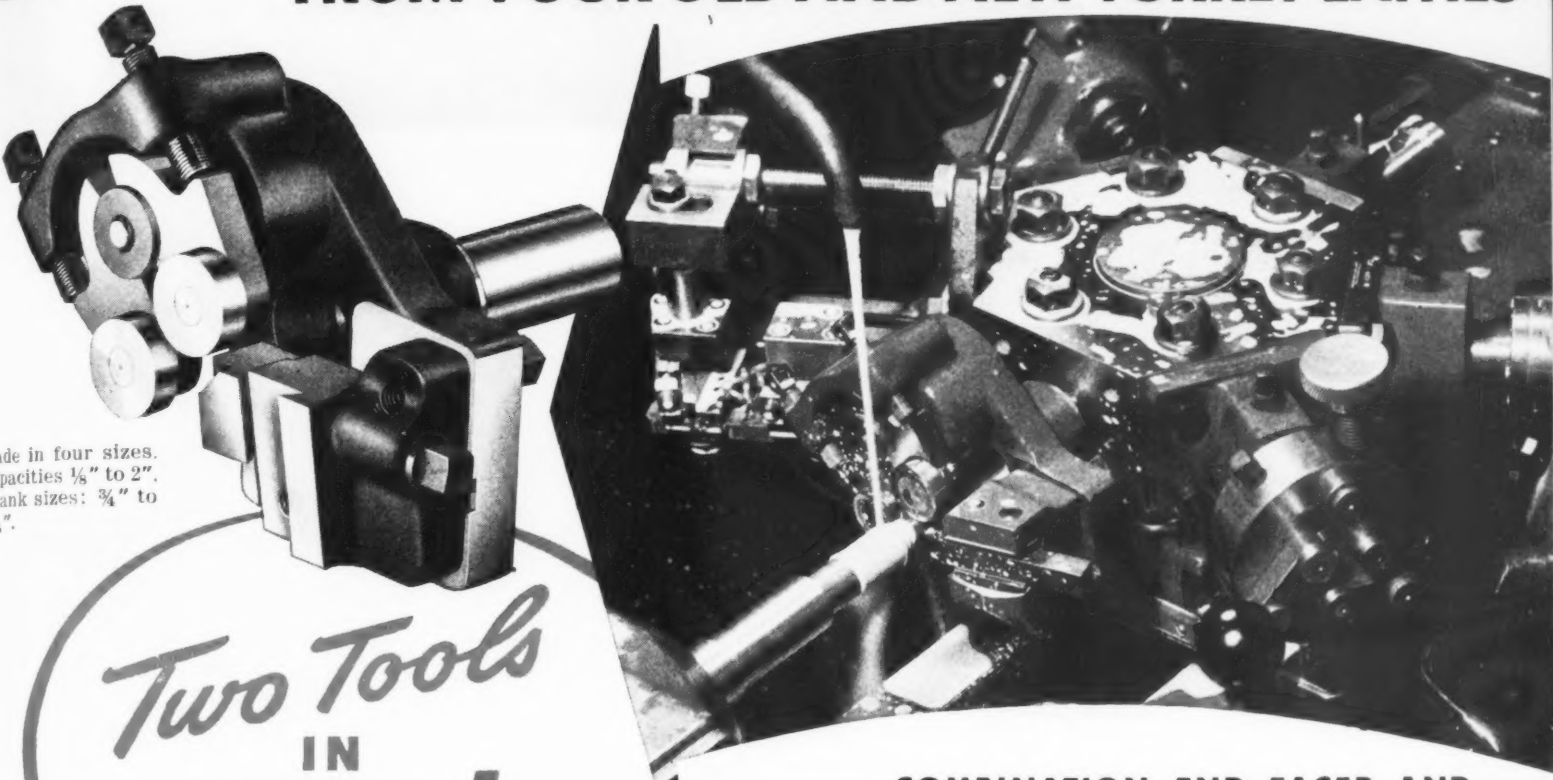
Are you satisfied that each unit of your equipment is delivering its full share of plant output? Ask a Gulf engineer to look it over and give you his suggestions for improved lubrication. He has had broad experience with all types of equipment similar to yours and can give you practical help in attaining peak efficiency in your plant. There is no extra cost — so why not take advantage of this cooperative service?

The Gulf line of 400 quality oils and greases is quickly available to you through more than 1200 Gulf warehouses in 30 states from Maine to New Mexico. Write or phone your nearest Gulf office today.

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION · GULF REFINING COMPANY · PITTSBURGH, PA.

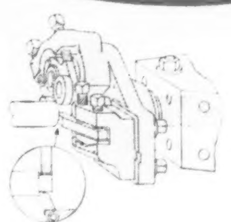
GET MORE PRODUCTION
FROM YOUR OLD AND NEW TURRET LATHES



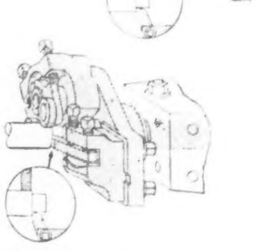
Made in four sizes. Capacities ⅛" to 2". Shank sizes: ¾" to 1¾".

Two Tools IN **ONE!**

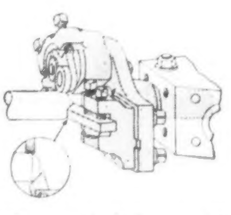
—for ALL Sizes and MAKES of Turret Lathes



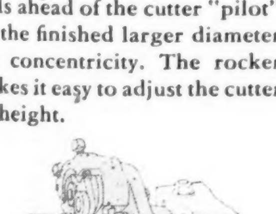
Turn Short Diameters—Using a square cutter, this combination tool becomes a Single Cutter Turner. Note the rolls follow the cutter to burnish the work to a fine quality finish.



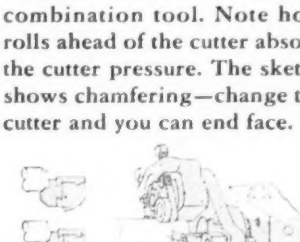
Turn Short Diameters Concentric—rolls ahead of the cutter "pilot" on the finished larger diameter for concentricity. The rocker makes it easy to adjust the cutter to height.



Chamfer or End Face with this combination tool. Note how rolls ahead of the cutter absorb the cutter pressure. The sketch shows chamfering—change the cutter and you can end face.



For End Forming with a Flat Cutter use this Combination End Facer and Turner. With this tool and flat cutters ground to the right shape, your end forming problems are solved.



As an End Former—dovetail-type form cutters replace the cutter block to turn standard shapes, forms and radii in the end of bars.

COMBINATION END FACER AND TURNER STEPS UP PRODUCTION ON SHORT SHAFTS, STUDS, BOLTS OR SHORT DIAMETERS.

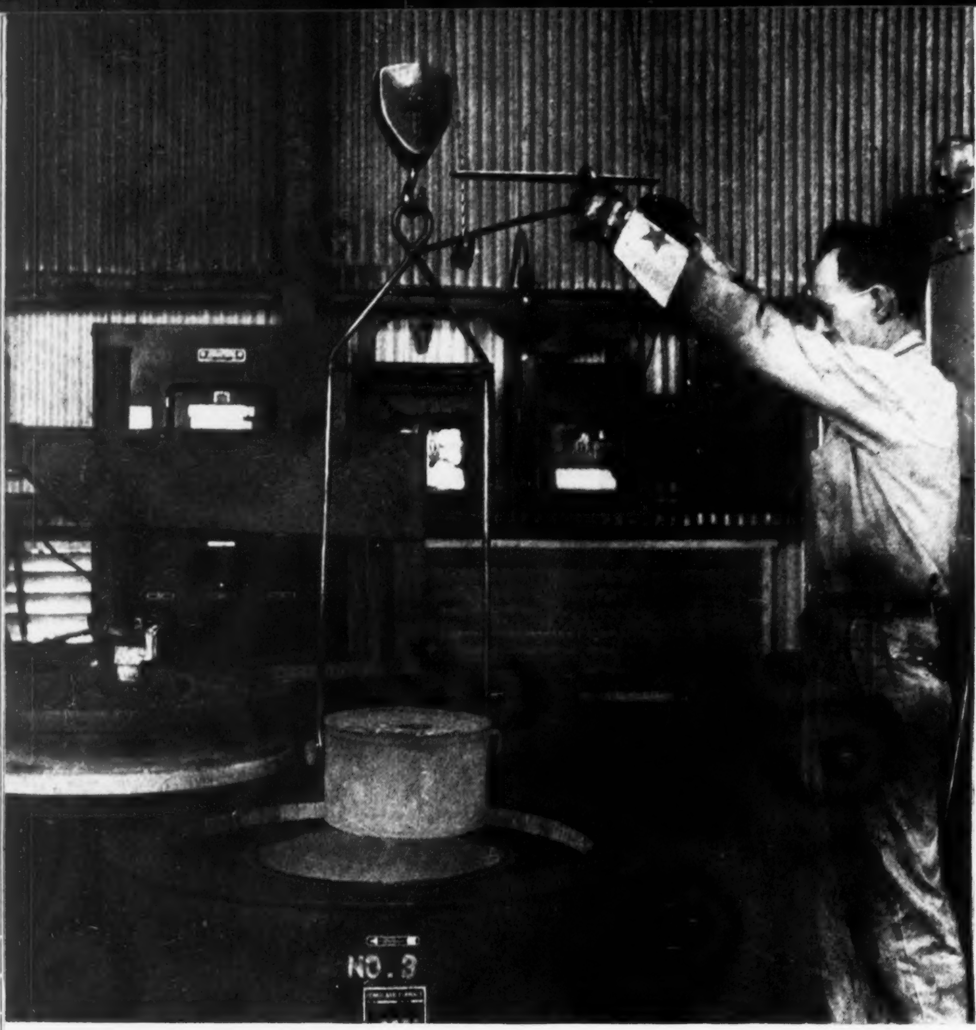
The diagrams show the wide adaptability of this inexpensive tool. It is only one of 596 small tools which have been redesigned by Warner and Swasey and are proving so successful in increasing the production capacity of both old and new turret lathes. The field engineering and factory "job study" staff of Warner and Swasey are utilizing these tools to plan new set-up and turning methods for hundreds of turret lathe users.

Here is a practical way—a quick and inexpensive way to make work easier for your operators, and at the same time increase the output of your turret lathes anywhere from 20 to 50%. Just write

Send for the Warner & Swasey Tool Catalog

WARNER & SWASEY
Turret Lathes

YOU CAN TURN IT BETTER, FASTER, FOR LESS...WITH WARNER & SWASEY TOOLS



Heat-treater is withdrawing a 300-lb load of Homo carburized cutters from the furnace, for air cooling. Homocarb Method here reduces heat-treating time by 33 per cent.

ANOTHER PLANT
Joins the "No-Rejects" Homo Carburizers

Within the past several months, there has grown up in the United States a small but interesting and important group of heat-treating departments.

Nearly every airplane-engine builder is included; so are many automobile companies, most machine tool builders, and some concerns in various other metal-working industries. This group can be identified by the fact that its members, in carburizing in the Homocarb way, work to rigid specs., with practically no rejects at all. Take, for example, the Globe Oil Tools Company, Los Nietos, Calif.:

Globe's nickel-steel cutters weigh from 3 to 12 lb each. They have hard-surface metal welded to their teeth (hence the "dirty" appearance in the photo) but are carburized on the inside bore, where they run on the bearing of a drilling tool. And the carburized case is held to within ±0.003", where the total case is 0.05 to 0.09 thick. There are no rejects, and the cost, compared with pack-carburizing, has been cut in half.

The reason for such results is that the Homocarb Method lets the heat-treater add carbon to the steel with genuine precision—he can build the case almost as accurately as the machinist can cut the steel blank. And he has no unexpected warp. Parts go through smoothly, on schedule, and emerge to specifications.

Cutters in Homocarb basket after carburizing.

For further information about the Homocarb Method, see Catalog T-623.

New! Automatic! Micromax Indicator For Temperature

For checking the temperatures of various thermocouples, in any desired order and with the "human equation" largely eliminated, we recommend the Model S Micromax Indicator. The equipment is particularly useful where a large number of couple temperatures must be logged by a process operator. To check a couple, the user simply snaps its toggle-switch, and the instrument points to the temperature.

This Indicator is our motor-driven potentiometer pyrometer, with recording mechanism omitted and provision added for switching any desired couple into the measuring circuit at any time.

Couples so indicated can be ones which are normally connected to Micromax recording equipment, and are simply switched to the Indicator for checking. If this is done, the Indicator's total capacity is reduced by one couple for each couple recorded; if all couples are indicated only, the capacity of the Indicator is 77 couples.

The case of the Indicator is the same as that of the Model S Micromax Recorder or Recording Controller. Indicator has automatic reference-junction compensator, manual standardizer. For further details, see Catalog N-33A(5).

Red-Face Corner

We strive, in preparing advertising messages, to under-state rather than over-state, but we don't intend to carry this policy so far as we recently did, in a bit we wrote about a Speedomax recorder.

This machine, we said, is used in General Motors' research lab, and records the temperature of steel during the quench which is part of heat-treatment. So far, so good; that's what this particular Speedomax does.

But, we also said that the machine records temperatures even when the latter is plunging downward at 70 degrees per second—and *that* turns out to be pretty ridiculous. For, though this particular cooling-rate is 70 per sec., Speedomax could keep up if it were 700. So we're sorry; if you're more interested now than before, we'll be glad to send further information.

Jrl Ad ENT-0600C(26)

LEEDS & NORTHRUP COMPANY, 4921 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

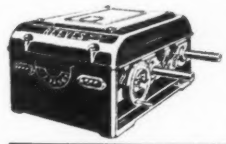
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Traffic Cop

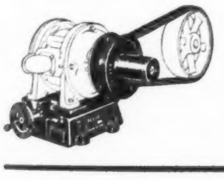
TO INDUSTRY

● There is a *right speed* for every job on every machine—and you can have it *every time with* REEVES *Variable Speed Control.* Merely by turning a handwheel, you can regulate production traffic through your plant as smoothly as a traffic cop regulates traffic on a busy corner—preventing traffic "jams" and moving the work along swiftly and efficiently. A machine running *too fast* may create so much spoilage that actual production is substantially reduced. A machine running *too slow* may clog up the entire production line, retarding output and raising costs. REEVES Speed Control provides *accurate adjustability* for every condition and contingency. First cost is low; maintenance negligible. Advantages are immediate and continuous. Don't experiment. Buy REEVES—dependability proved in over 140,000 installations.

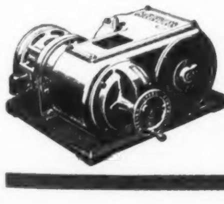
THE 3 BASIC REEVES UNITS



VARIABLE SPEED TRANSMISSION for infinite speed control over wide range—2:1 to 16:1 inclusive—and for heavy duty service. Fractional to 87 h.p. capacities.



VARI-SPEED MOTOR PULLEY for direct application to shaft extension of any standard motor and for ratios of speed variation not exceeding 3:1 range. Fractional to 15 h.p.



MOTODRIVE which combines motor, variable speed drive and gear reducer in a single compact unit. Fractional to 10 h.p. capacities; speed range 2:1 through 6:1.

Write for our new "Speed Up" book. Illustrates and describes how 36 different plants are speeding up production with accurate, variable speed control.

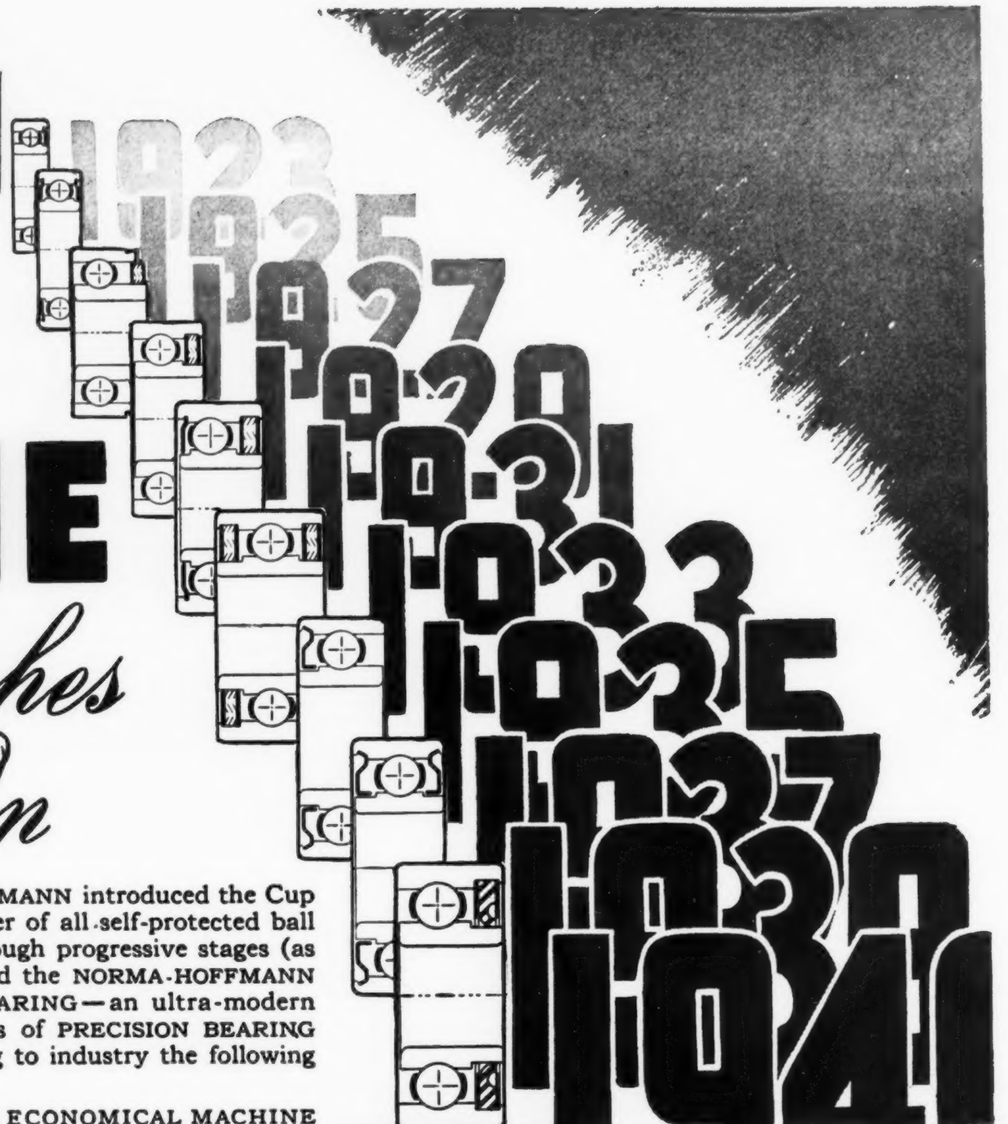
REEVES PULLEY COMPANY, Dept. M, COLUMBUS, INDIANA

Recognized Leaders in Variable Speed Control Engineering

Accurate Positive **REEVES SPEED CONTROL**

Classified Contents of this Number

1921



TIME *Marches On*

In 1921, NORMA-HOFFMANN introduced the Cup Mounting—the forerunner of all self-protected ball bearings. From this, through progressive stages (as shown above) has evolved the NORMA-HOFFMANN "CARTRIDGE" BALL BEARING—an ultra-modern type embodying 30 years of PRECISION BEARING manufacture and offering to industry the following distinctive advantages:

SIMPLER AND MORE ECONOMICAL MACHINE DESIGN, due to elimination of many costly mounting parts and machining operations, otherwise required; EASIER AND FASTER MACHINE ASSEMBLY AND DISASSEMBLY, since the "CARTRIDGE" BEARING is an integrally sealed unit needing no complementary mounting parts; 100% GREATER GREASE CAPACITY, due to double-row width creating a greatly enlarged grease reservoir; COMPLETE AND LASTING EXCLUSION OF DIRT AND FOREIGN MATTER by the use of tightly fitting, wearless, all-metal seals; SEALED FOR ANY POSITION, since the seals retain the lubricant regardless of shaft angle; EASY REGREASING AND INSPECTION WITHOUT DISMOUNTING, by means of refilling plug and removable seals.

Write for the Catalog. Submit your bearing problems for study and recommendation, without obligation. NORMA-HOFFMANN sales and service engineers, and distributors in principal cities stocking "CARTRIDGE" BEARINGS, are at your service.

"NORMA-HOFFMANN"

CARTRIDGE

BALL BEARING

PRECISION BALL, ROLLER and THRUST BEARINGS

NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN., U.S.A. • FOUNDED 1911

Portrait of a FAMOUS HEAD

—famous because it's helping to speed up work wherever cap screws are used.

How?

Because the cold-forged Knurled "Unbrako" heads gear right to the fingers . . . there's no slip, no loss of time and the mechanic is pleased because he prefers to use his fingers instead of a wrench.

In addition, the knurling also permits quick and easy locking of the screw after countersinking—a big advantage!

These and other Knurled "Unbrako" advantages are yours at NO EXTRA COST . . . yours by specifying Knurled "Unbrako" on your next order. Try it.

"UNBRAKO" HOLLOW SET SCREWS with the KNURLED POINTS

Equally popular is this "Unbrako" Self-Locker. The knurled points automatically lock into place . . . hold the screw tightly no matter how severe the vibration. Yet the "Unbrako" Self-Locker is as easily removed as applied and can be used repeatedly . . . always with the same dependable grip! A note on your letterhead brings catalog and prices—no obligation.

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. BOX 22
— BRANCHES —
BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO

Well Known Automobile Maker Uses Barber-Colman Hob Sharpeners EXCLUSIVELY!

13 B-C Automatic Hob Sharpening Machines handle all of this work in a large automobile plant . . . and two men keep them busy. Above is one of the No. 3 Sharpeners in operation. Each of these machines is continuously set up for hobs of specific types and sizes, straight or spiral gashes, which reduces set-up time to a minimum. Grinding wheels are used most effectively by running new 7" wheels on machines sharpening the largest hobs, then when worn to 6" diameter they are put on machines handling smaller hobs.

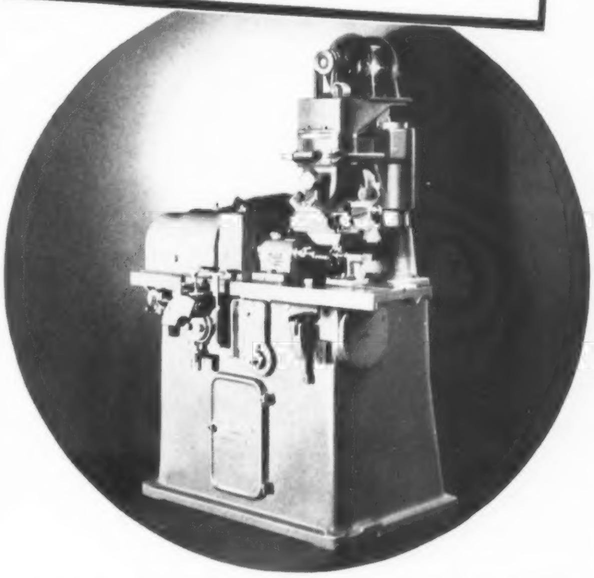
B-C Automatic Sharpening Machines Save Time and Labor in Sharpening HOBS and FORMED CUTTERS

Best machining results are obtained when your hobs and formed cutters are sharpened on B-C Automatic Sharpening Machines — and you make important savings in man hours, machine hours, sharpening costs, and tool costs. That is why many leading manufacturers use them exclusively.

Sharpening is entirely automatic and all important sharpening functions such as spiral angle, indexing, and feed on the machine are under positive mechanical control. This results in accurately sharpened tools and insures the constant duplication of original tool performance.

The machine is easy to set-up and one man can run up to four B-C Sharpeners on mixed hobs or cutters. Average hob sharpening time is about 20 minutes, leaving the operator time to tend other sharpeners or a production machine. Even greater time-savings are obtained when sharpening is specialized on a specific class of work for each machine, as in the case illustrated above.

Consult a Barber-Colman representative, without obligation, about what this economical correct sharpening can do for you. He will gladly call upon request.



● B-C No. 3 Automatic Sharpening Machine, shown above, sharpens hobs and formed cutters up to 4" diameter by 4" face with 7" grinding wheel. Our larger No. 4 Automatic Sharpening Machine has hydraulic table control, and sharpens work up to 10" diameter by 12" face with 10" wheel.

Write for bulletins describing distinctive advantages — Bulletin No. 654 covers the No. 3, and Bulletin No. 1011 covers the No. 4. These will be sent promptly upon request.

BARBER B-C COLMAN PRODUCTS

HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

Barber-Colman Company

General Offices and Plant 203 Loomis St., Rockford, Illinois, U. S. A.

MADE IN ROCKFORD, ILLINOIS, U. S. A.

Use BARNESDRIL Hydrams for High Production Drilling

For high-production drilling at low cost, use BARNESDRIL Hydrams. They have all the usual qualities required in high-grade machine tools, and *two exceptional characteristics* that give unusually high production, easy operation and economy on a wide variety of work.

Powerful Pull . . . One of these advantages is that final application of power for rotating cutting tools is made *below the ram.* This reduces torsional vibration; promotes smooth, uniform, efficient cutting on all kinds of work.

Hydram Feed . . . Hydraulic feed, *directly over the center* of the cutting tool or multiple-spindle head, is another exceptional Hydram characteristic. This gives automatic operating cycles of rapid approach, one or more feed-rates, dwell if desired, and quick return. It combines with the powerful drive for maximum production, saves labor, enables operators to run several machines, promotes high quality and accuracy in finished work. Made in 3 sizes, Hydram Drilling Machines are exceptionally productive on a wide range of work. Investigate. Write for Bulletin 134D, today.

DRILLERS BARNESDRIL HONERS BARNES DRILL CO.

At right, H-2 Hydram with 3-spindle head and 4-station fixture on indexing table. For drilling piston pins lengthwise in 3 stages successively. Quick-acting chucks take many different sizes. Holes drilled range from $\frac{7}{16}''$ diameter to $1\frac{1}{2}''$ diameter, with lengths in proportion. One of many high-efficiency Hydram applications. Write for details and additional data. Ask for Catalog M.

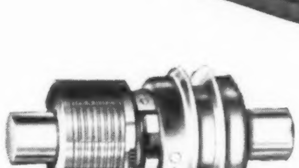
Barnes Drill Co. 814 CHESTNUT STREET ROCKFORD ILLINOIS, U. S. A.

PULLMORE CLUTCHES Prove "Very Satisfactory"

In Pease Continuous Blueprinters

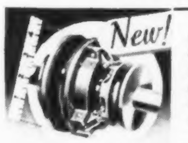
The washer and dryer drive in Pease Streamlined Continuous Blueprinting Washing and Drying Machines required a clutch having the following qualities: Easy operation, compactness, smooth engagement, positive pull and reserve capacity. In cooperation with our engineers, Pease designers selected Pullmore Single-type Multiple-Disc Clutches for the service indicated. Highly successful operation in Models "22", "16"; and the new popular Combination "22-16" illustrated, proved that Pullmore Clutches meet all the requirements, and are "very satisfactory as component parts of Pease Continuous Blueprinters".

Made in Single and Double types, for operation in oil or dry, in complete range of capacities up to 75 h.p. at 500 r.p.m.; Pullmore Clutches are similarly successful in machine tools, industrial trucks, cranes, hoists, wire coilers and many other automatic or semi-automatic machines. Pullmore Blue Book shows typical installations, has complete technical data . . . Write, today, for your copy. Ask about our free engineering service.



Single-Type Pullmore Clutch

A No. 2 Single-type Pullmore Clutch gives easy operation, smooth pick-up and steady powerful pull in the washer-dryer drive of the popular Pease 22-16 Blueprinting Machine shown above.



New! **LMC Clutch** — Rockford Plate Clutches, Over-Center and Spring-Loaded Types, are available in many sizes up to 80 h.p. at 100 r.p.m. Latest, and smallest is O-C type LMC, shown at left; capacity, 1 h.p. at 100 r.p.m.; 6 h.p. maximum at higher speeds.

PULLMORE CLUTCHES are sold by

MORSE CHAIN CO., Ithaca, N. Y., offices in principal cities

Rockford Drilling Machine Division

Borg-Warner Corporation

310 Catherine Street, Rockford, Illinois, U. S. A.

OVER-CENTER CLUTCHES • SPRING-LOADED CLUTCHES • PULLMORE CLUTCHES

MADE IN ROCKFORD, ILLINOIS, U. S. A.

Production

At WRIGHT
Aeronautical Corporation On Miscellaneous Shafts

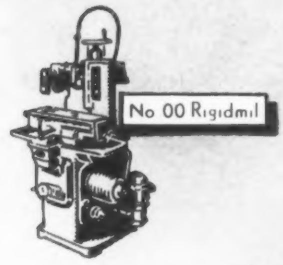
Shown on the opposite page are four typical work-pieces from the miscellaneous shaft department of Wright Aeronautical Corporation, Paterson, N. J.; where a wide variety of work is turned to high standards of accuracy and finish. Engineered Production and Sundstrand Automatic Stub Lathes increased output on these pieces an average of 56%, and give equally satisfactory service on a large number of other jobs.

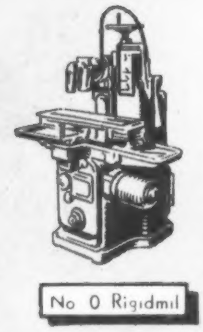
Sundstrand Automatic Lathes provide easy set-up and quick change-over to maintain high production, quality and economy on small-lot work. For example, Model 8 shown opposite does two operations on airplane motor pump shafts. Twenty to 25 minutes suffice to change the Sundstrand set-up from one group of operations to the other. Setting-up for a new job is rapid because cycle-control cams are "out" . . . Sundstrand Automatic cycles are established quickly by adjusting dogs on a convenient graduated disc. Large numbers of speeds, feeds and cycles are available for quick, easy selection. Sundstrand standard tool blocks, and micrometer adjustments of tool slides, also speed set-up and production.

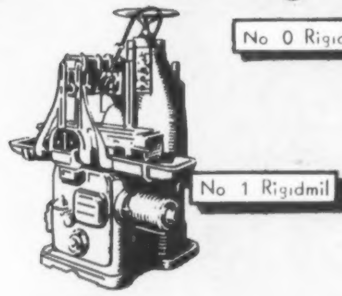
For mass production, Sundstrand Automatic Lathes have the power, strength and rigidity to work high-speed cutting tools at maximum capacity in any metal; and the stamina to keep on running steadily in such service, with minimum maintenance.

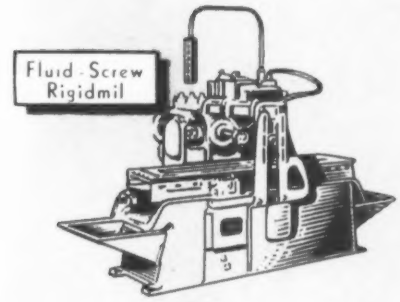
On small-lots and long-runs Sundstrand Automatic Stub Lathes swing into high production quickly. Their operators need no special skill, little preliminary training; and easily complete full shifts efficiently without excessive fatigue.

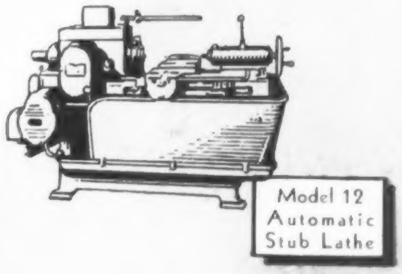
★ For high production on today's turning, take full advantage of your Sundstrand Automatic Stub Lathe qualities. For speed on next year's turning, order your Sundstrand Automatic Stub Lathes now. For best results any time on manufacturing turning or milling, use Sundstrand Engineered Production.

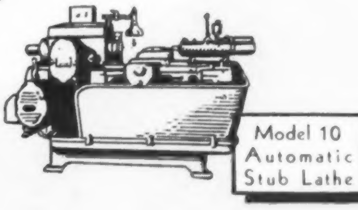












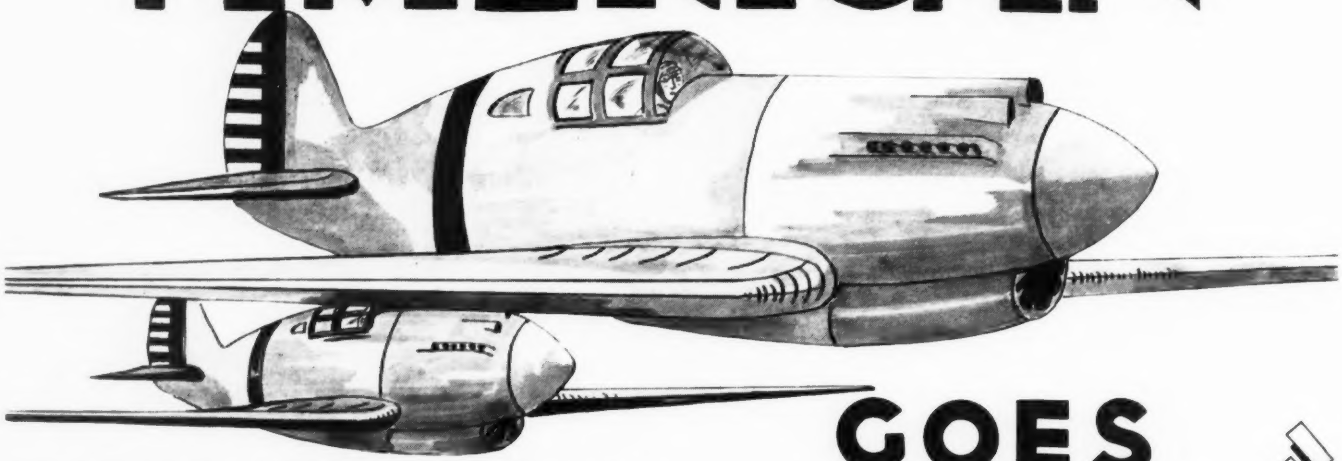
In their respective fields, Sundstrand machine tools are unexcelled for high production, accuracy, and lasting value. Write for complete details.

MACHINE TOOL CO.

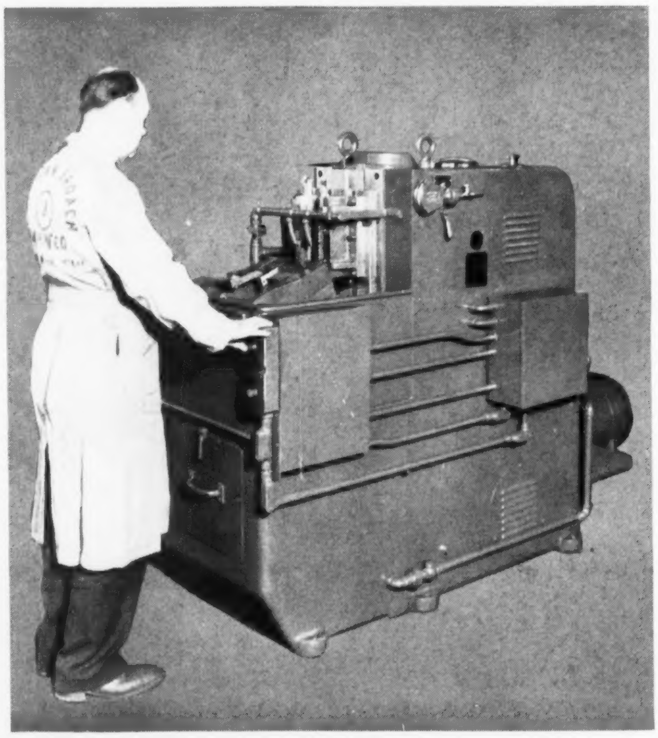
ROCKFORD, ILLINOIS, U. S. A.

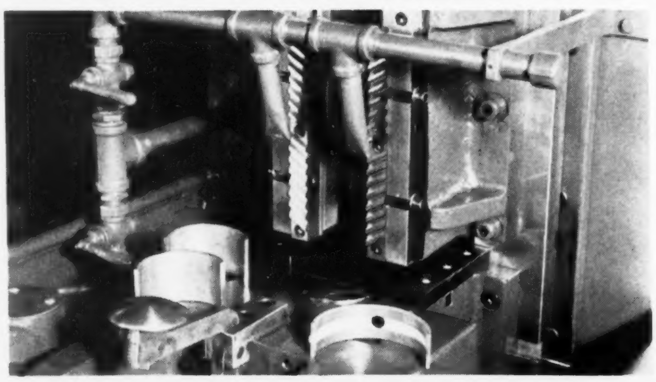
MADE IN ROCKFORD, ILLINOIS, U. S. A.

AMERICAN



GOES "ALL OUT" FOR DEFENSE





AMERICAN has recently produced the special vertical hydraulic surface broaching machine shown at the left. The machine is arranged to broach the joint face of steel back babbitted bearings removing a maximum of .010, and finishing to an accuracy of .0003.

Photograph at upper left shows operator with machine in position to start broaching stroke. The parts to be broached are loaded into the work nest on the work table shown in the lower left photograph.

At the end of the broaching stroke, the work is unclamped, the table swings up to loading position and the machine slide returns to the upper end of the stroke while operator loads the next part.

This machine is a low tonnage, short stroke speed unit designed to maintain the extremely close tolerances necessary, with broach holder mounted on the hardened and ground machine slide and the fixture mounted on the receding table unit. Production of over 500 pieces an hour is obtained.

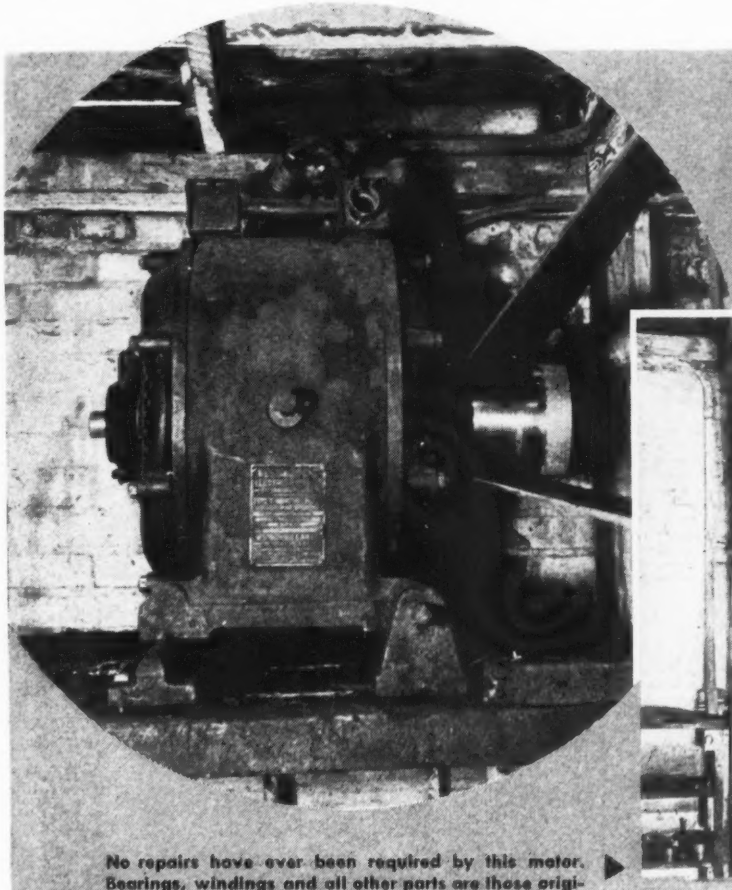
AMERICAN BROACH & MACHINE COMPANY
ANN ARBOR, MICHIGAN, U. S. A.
BROACHING MACHINES, PRESSES, BROACHING TOOLS, SPECIAL MACHINERY

Division of SUNDSTRAND MACHINE TOOL CO. ROCKFORD, ILLINOIS, U.S.A.

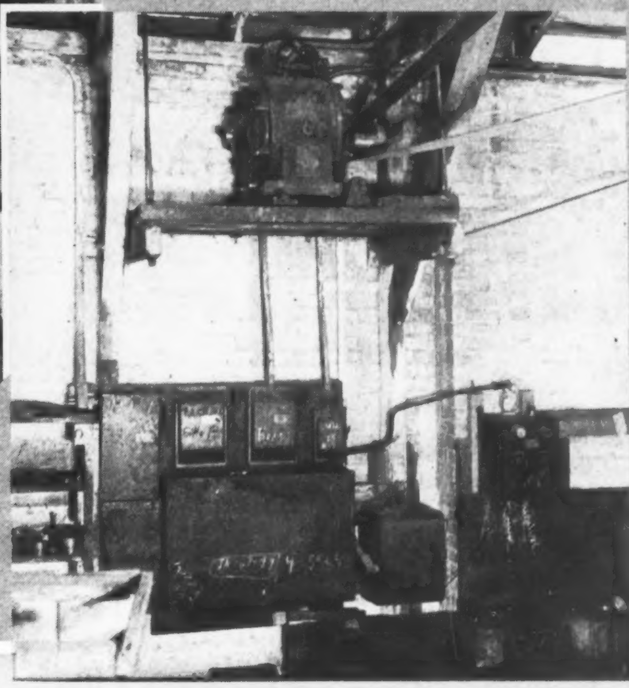
A Division of
SUNDSTRAND MACHINE TOOL CO. ROCKFORD, ILLINOIS, U. S. A.

JOB

AND NOT ONE PENNY SPENT FOR REPAIRS



TOO GOOD TO BE TRUE but a fact, nevertheless. Here's the Westinghouse motor originally purchased by J. R. Coats in 1900... in continuous service ever since...and still on the job 15 to 20 hours per day in the Visalia Foundry, Machine Shops & Garage, in Visalia, Cal. No repairs have ever been necessary.



No repairs have ever been required by this motor. Bearings, windings and all other parts are those originally on the motor when purchased 40 years ago.

Out in Visalia, California, there's a Westinghouse motor that has been on the job for 40 years. This motor still has its original bearings, windings and all other parts and hasn't cost the owner a penny for repairs. You might think it would be ready for "honorable" retirement. But no . . . this motor is still going strong . . . still giving 15 to 20 hours a day of dependable, low cost service.

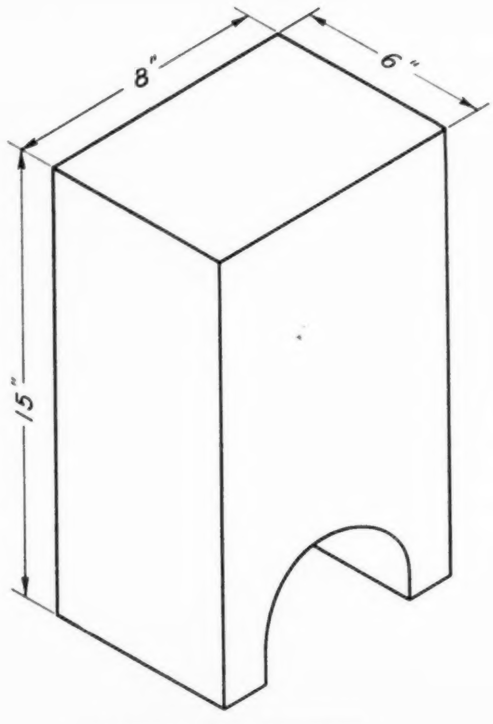
We'd cite this record as an example of the service you can expect from Westinghouse motors, but someone would say, "They don't build motors like they did in the old days."

Which is correct . . . today's Westinghouse motors *are different*. They're better! Very little remains of that old motor design except its good features. The rest is all changed . . . changed because of what we've learned about motors in the 40 years . . . changed by 40 years of motor research . . . changed by 40 years of improvement in Westinghouse manufacturing methods.

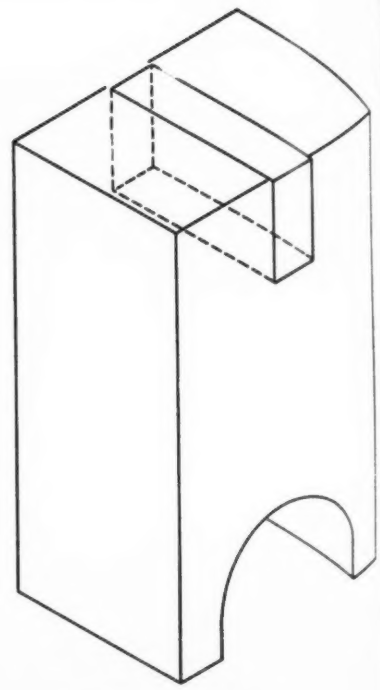
WESTINGHOUSE ELECTRIC & MANUFACTURING CO., EAST PITTSBURGH, PA.

Motors and Control

ANOTHER HIGH-SPEED MUNITIONS BROACHING JOB BY



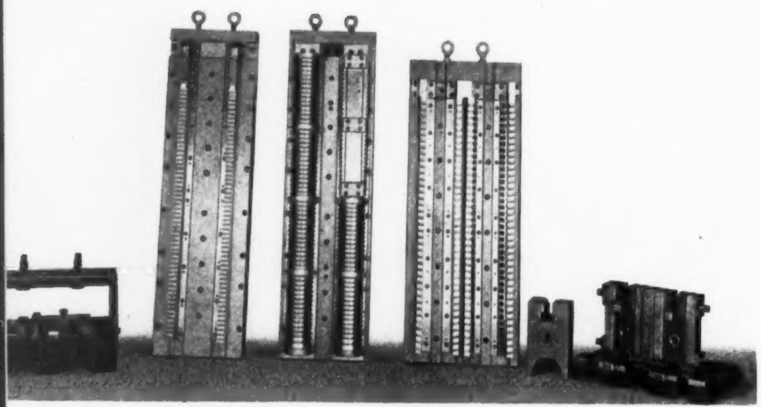
BEFORE BROACHING

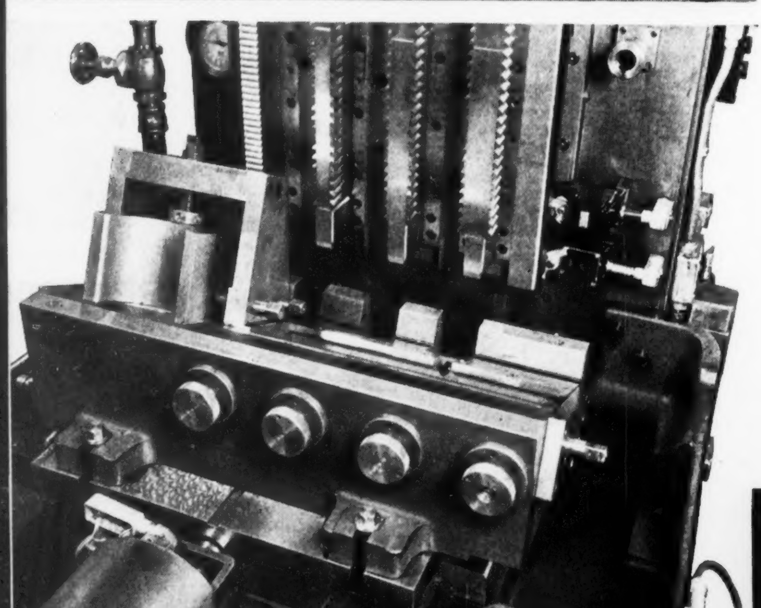


FIRST OPERATION

LAPOI

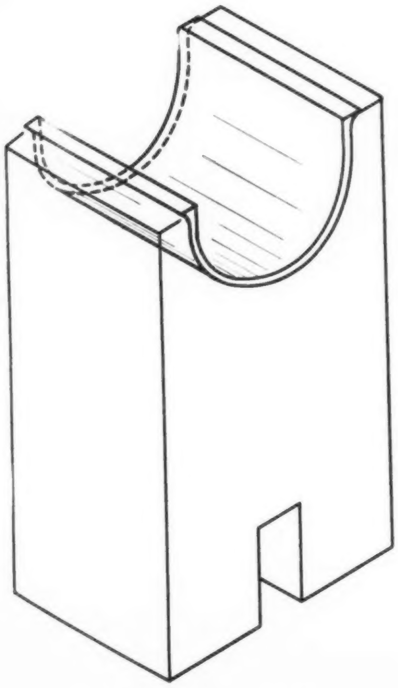
ON 90 M.M. ANTI-AIRCRAFT



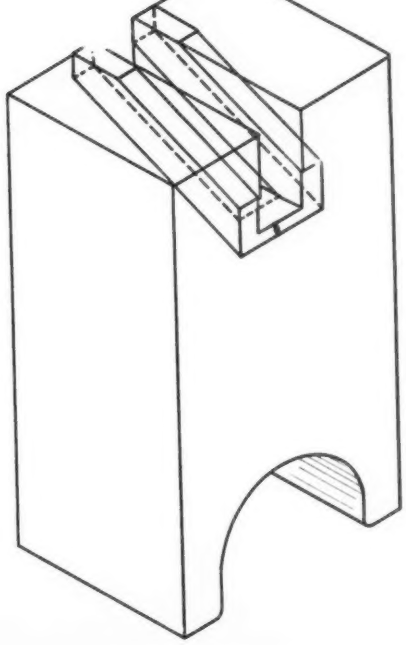


Another job of munitions production, speeded up with Lapointe Broaching Machines, Broaches and Fixtures! The 6 x 8 x 15 inch block, shown in the drawings above, is broached on four surfaces with the Lapointe 30 Ton Vertical Hydraulic Broaching Machine illustrated at the right.

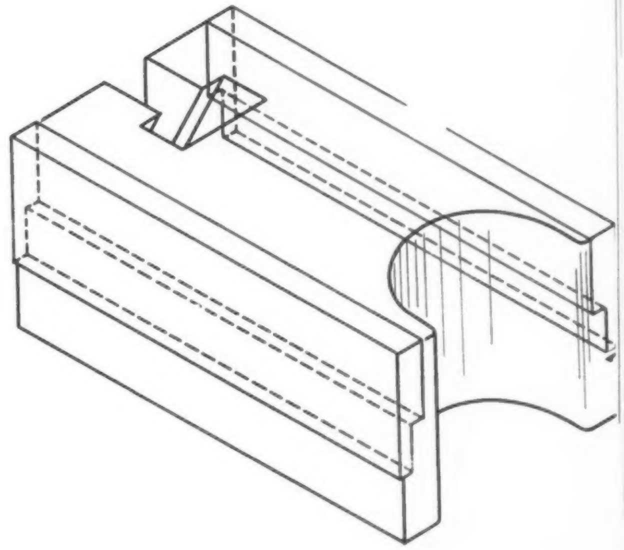
The slot shown in the first operation is broached from the solid in eleven progressive cuts. The half-round is then broached in one roughing and one finishing cut. The T-slot shown in the third operation must be very accurate as to location, angle and size. Four rows of broaches are used to produce this slot, the work being held in a vise-like holder and fed from one broach to the other by the use of four stops to obtain accurate location. A close-up of this operation is shown below, left. In the final operation two steps are finished on the entire length of the 15 inch dimension. In this operation approximately 75 cubic inches of metal are removed in 20 minutes.



SECOND OPERATION



THIRD OPERATION



FOURTH OPERATION

INTE

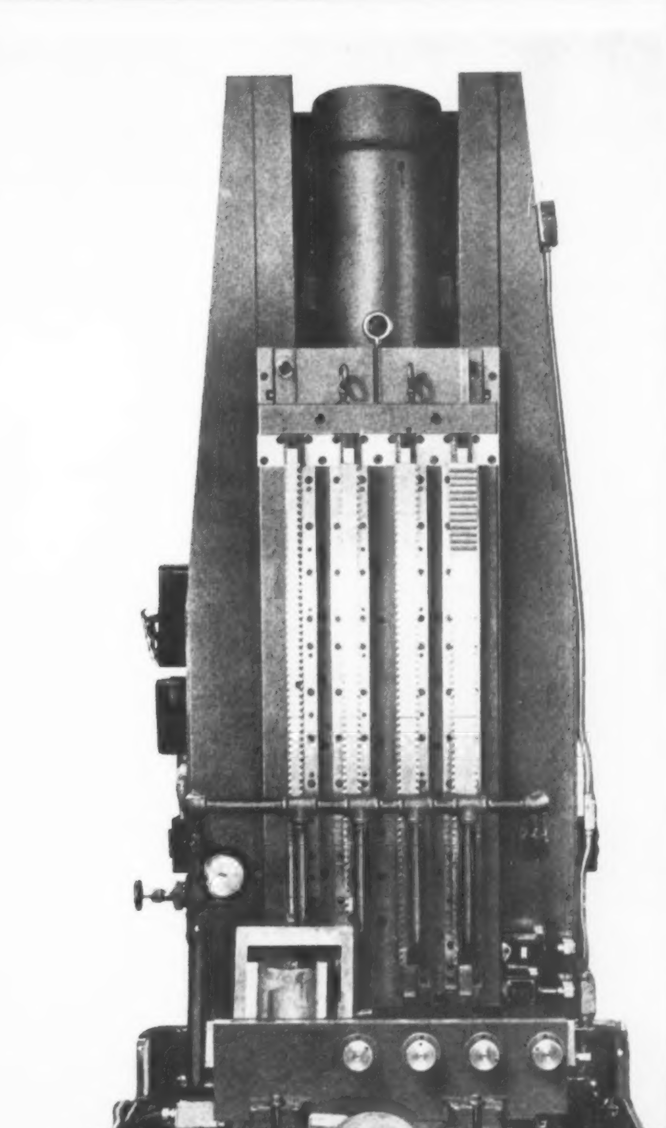
AFT

GUN BREECH BLOCKS . . .

All of these operations are performed on a Lapointe 30 Ton, 66 inch stroke single ram broaching machine with a built-in, hydraulically operated reciprocating table. To obtain the accuracy and the high quality finish necessary for this part, Lapointe engineers developed an unusual broach design and a unique method of handling the blocks.

To meet the intensive production demands of munitions manufacture Lapointe engineers are constantly widening the applications of broaching, increasing speed and accuracy and making it possible to produce aircraft and munitions parts **better, faster,** at **lower costs.** Let us help improve your production for National Defense by developing Broaching Machines and Broaches that will produce accurately finished parts in one quick, efficient operation.

WRITE FOR DETAILS



News

FORMER "DRY SPOT" Now Gets OIL A-PLENTY

Pins and Bushing Surfaces Fed By Exclusive Design of MORSE ROLLER CHAIN

Oil Gets In - Wear Stays Out!

That's NEWS! That's *good* news! For the pin and bushing surfaces of roller chain used to be the trouble spots, the place where failures frequently occurred because of insufficient lubrication.

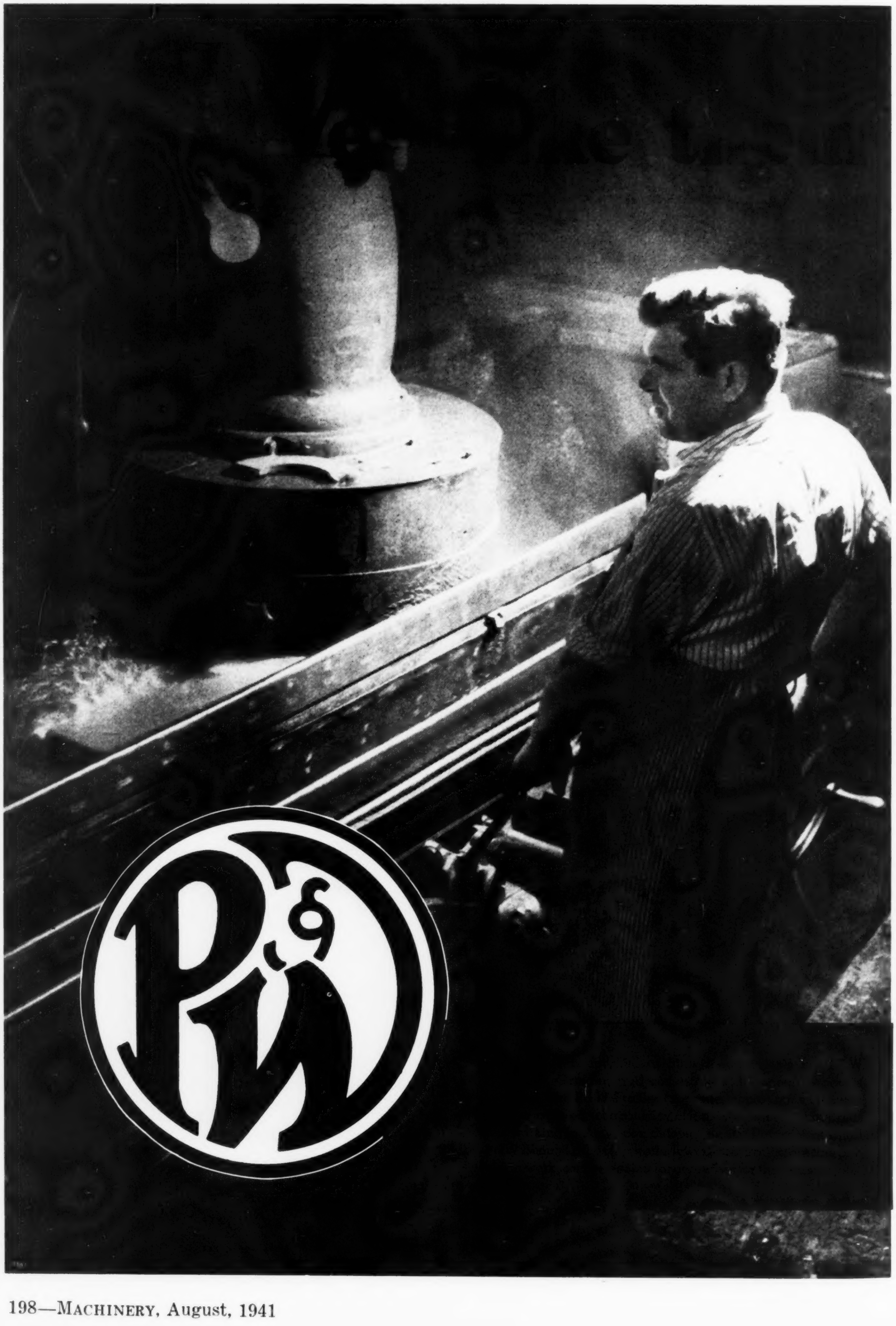
But not with Morse Roller Chain now. Channels in the bushings lead oil through the sideplates down to the pin and bushing surfaces. The Morse design puts a "force-feed" lubrication system in every link. Oil gets in—wear stays out.

Get the advantages of Morse longer life, smoother operation, higher efficiencies for *your* roller chain drives. Morse roller chains are interchangeable with other roller chains, and they're available in all standard sizes, single and multiple widths. Call in the Morse man near you, or write direct to Morse, Ithaca.

SILENT CHAINS   ROLLER CHAINS   FLEXIBLE COUPLINGS   CLUTCHES

MORSE *positive* DRIVES

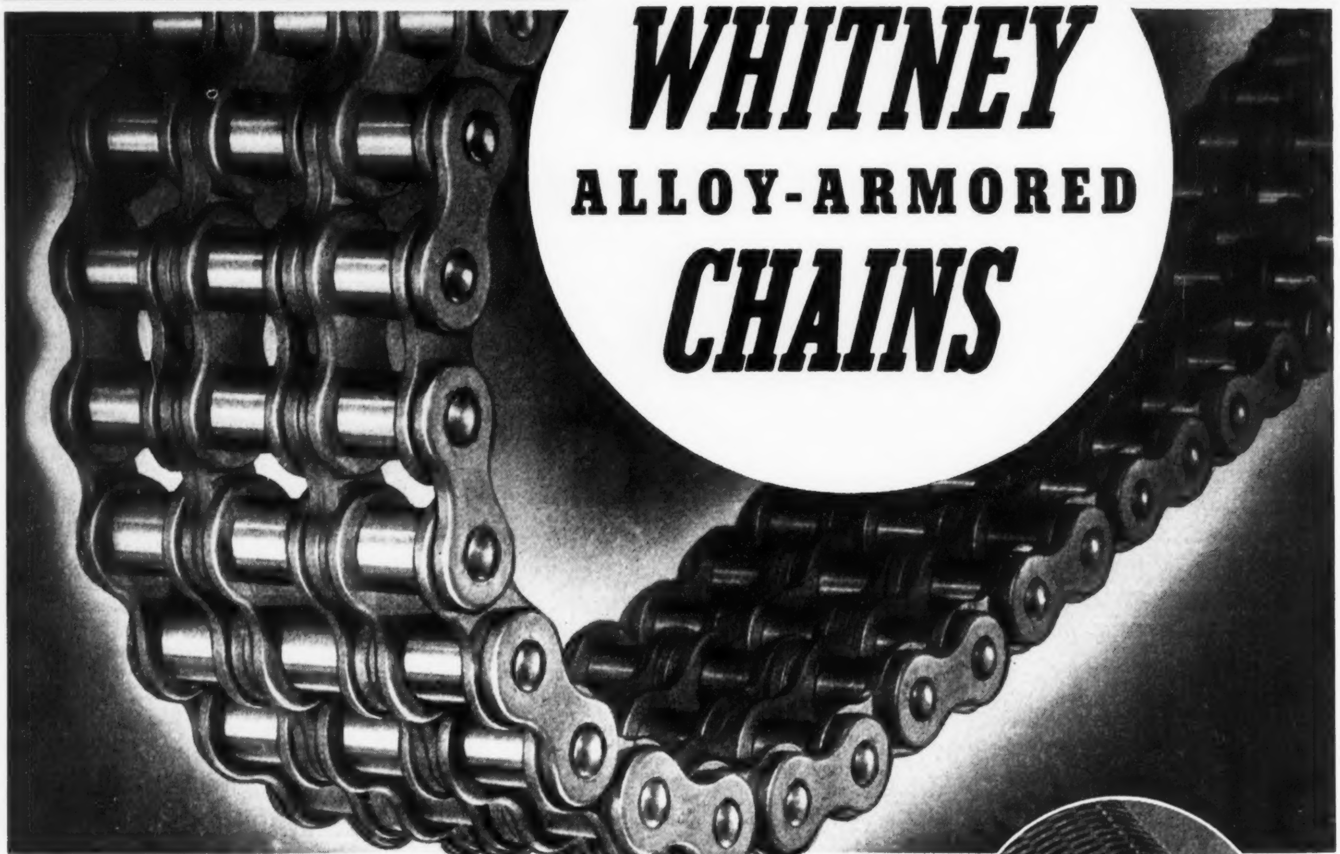
MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

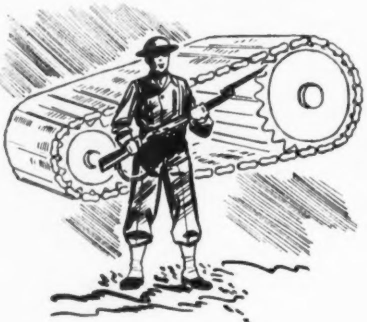


Protect Power's "Line of Supply" to the Production Front

WITH

WHITNEY
ALLOY-ARMORED
CHAINS





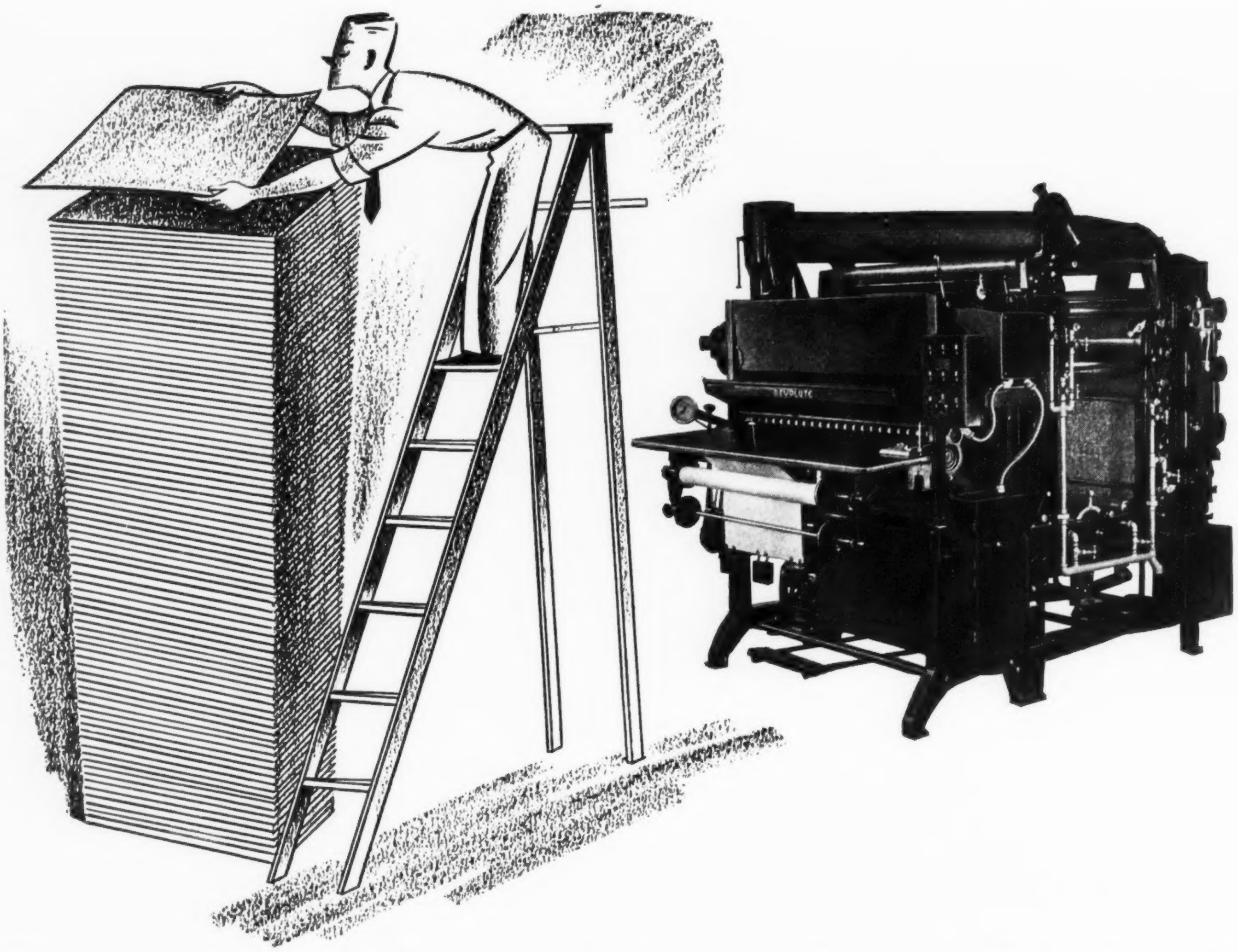
"Now is the time for all good machines to come to the aid of the country." And that calls for each machine to be *a full effective* in the campaign for top production.

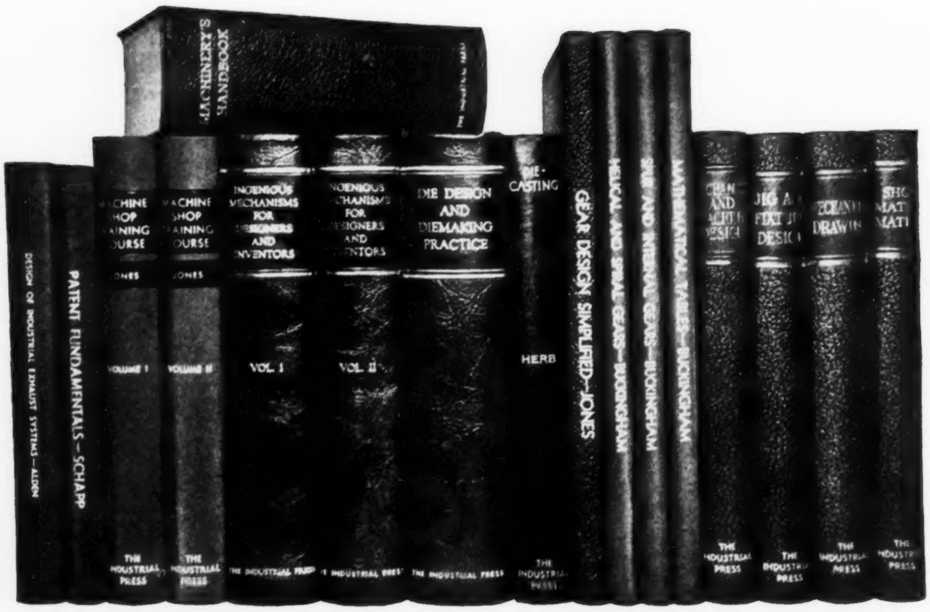
So, as a defense measure in machine operation, transmit power to the job with Whitney Chains on all group and individual drives. Whitney Chains cut power losses in transmission . . . maintain constant speeds that protect product-uniformity . . . *help machines to turn out more work per hour*. And Whitney armors each chain with tough alloy steels that increase the life of each drive-unit, and prevent production delays. On every count, it pays to design Whitney Chains into the machines you're building . . . and install them on the machines you're operating. And there's no time like the present to talk it over with a Whitney engineer. *Write.*

Whitney Products

Roller Chain & Sprockets, Silent Chain & Sprockets, Conveyor Chain & Sprockets, Roller Chain Flexible Couplings, Automatic Load Limiting Sprockets, Automatic Drive Tensioners, Woodruff Type Machine Keys and Cutters.

The Whitney Chain & Manufacturing Co., Hartford, Connecticut


REVOLUTE



Standard Engineering Books

Write on Order Form Below the Titles You Want

MACHINERY'S HANDBOOK
For engineers, machine designers, toolmakers and machinists. Latest (10th) edition. 1815 pages. $6.00.

USE OF HANDBOOK TABLES AND FORMULAS
Companion book for 10th edition of MACHINERY'S HANDBOOK. Contains practice exercises and test questions based on the Handbook contents. $1.00.

GEAR DESIGN SIMPLIFIED
Working rules, formulas and practical examples applying to all types of gears. $3.00.

SHOP MATHEMATICS
Problems arising in everyday machine shop and toolroom practice. $3.00.

JIG AND FIXTURE DESIGN
Design and construction of jigs and fixtures for drilling, boring, planing, milling, etc. $3.00.

MANUAL OF GEAR DESIGN
By Earle Buckingham. In three sections: I, Mathematical Tables applicable to gear design; II, Spur and Internal Gears; III, Helical and Spiral Gears. All three books, $7.00. One section, $2.50.

ELEMENTS OF MECHANICS AND MACHINE DESIGN
Fundamental mechanical principles and their application to machine designing problems. $3.00.

DIE DESIGN AND DIEMAKING PRACTICE
Design, construction and application of all types of dies. 956 pages. $6.00.

MACHINE SHOP TRAINING COURSE
Elementary and advanced machine shop practice for shop courses, schools and self instruction. Complete two-volume course, $6.00; either volume separately, $4.00.

MECHANICAL DRAWING
How to draw mechanisms and machine details, dimension, check and read drawings. Includes numbering and filing systems. $3.00.

DESIGN OF INDUSTRIAL EXHAUST SYSTEMS
Shows how to design, build or buy an exhaust system for dust and fume removal. $3.00.

INGENIOUS MECHANISMS FOR DESIGNERS AND INVENTORS
In two volumes. Price of both, $8.00; either volume, $5.00.

- *ORDER FORM* -

THE INDUSTRIAL PRESS, 148 Lafayette St., New York

Send me, postpaid, the following books, or book. I enclose (1) payment in full. (2) or a first payment of one-third the total amount due and balance payable in monthly installments. I have the right to return any book within 5 days and money will be refunded.

Book Title ....

Book Title ....

Name ....

Home Address .... City and State ....

*Firm .... *Position ....

*This additional information for our private records would be appreciated. M-8/41

3 WEEKS *for* DIE HEADS *and* TAPS

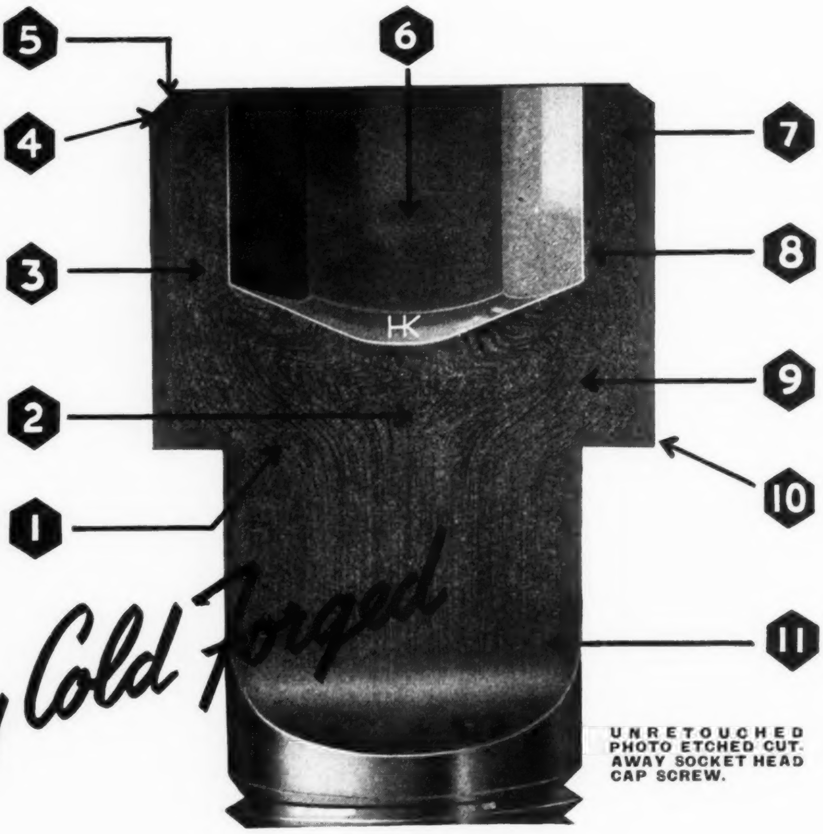
● Accuracy and speed are the order of the day. Rickert-Shafer secondary tools offer both in greater degree than ever. Skilled hands have refined Rickert-Shafer Taps and Die Heads to eliminate all waste setup effort. In spite of the increasing demand for Rickert-Shafer tools to meet specific threading work, we are prepared to make 3 weeks delivery on the tap or die head that you need for defense work. A job well begun is only half done, let's follow through.

The RICKERT-SHAFER CO., Erie, Pa.

Specialists in ACCURATE THREADING at GUARANTEED LOW COST

HOLO-KROME FEATURES

1—INCREASED STRENGTH.
2—CONTINUOUS UNCUT LATERALLY DEFLECTED CORE FIBRES.
3—CONTINUOUS UNBROKEN FIBRES.
4—SMOOTH FLAT TOP WITH SLIGHT CHAMFER.
5—CONCENTRICITY OF HEAD WITH BODY.
6—SOCKETS — UNIFORMLY ACCURATE TO FULL DEPTH OF HOLE —TRUE HEXAGONAL SHAPE— ACROSS FLAT SECTION DIAMETER IDENTICAL TOP AND BOTTOM—NO TAPER—SMOOTH REGULAR WALLS — WELL DEFINED CORNERS.
7—CONTINUOUS FIBRES ENDING IN SOCKET WALLS.
8—REINFORCED SOCKET WALLS.
9—CONTINUOUS UNCUT FIBRES.
10—SQUARE SHOULDERS.
11—ORIGINAL CONTINUOUS FIBROUS STRUCTURE.



UNRETOUCHED PHOTO ETCHED CUT-AWAY SOCKET HEAD CAP SCREW.

Results of a Superior Method in SOCKET SCREW Manufacturing

In Socket Head Screws where strength, both in the shoulder and in the Socket is essential, continuous fibres are of vital importance. Fibres originating in the shank must continue uninterrupted, unbroken and uncut around the Socket bottom, between it and the shoulder of the Screw and end in the Socket walls.

When this occurs, those portions of the Screw through which the continuous fibres pass, are reinforced and the finished Screw has all the properties of the original material, plus additional advantages developed by the manufacturing process.

In Holo-Krome FIBRO FORGED Screws, the core fibres are all retained and maintain their continuity. As you will notice in the illustration above, they are laterally deflected to form the bottom of the Socket and are compacted to add strength at the portion below the Socket and above the shoulder of the Screw.

Designers of modern Machines and Equipment fully realize the many advantages of this Superior Method, patented and exclusively used by Holo-Krome. They also know, Weight, Space and Assembly Time are Saved by specifying these Completely Cold Forged Socket Screws.

WRITE "HOLO-KROME" in your Specifications for Guaranteed UNFAILING PERFORMANCE

HOLO-KROME

Completely Cold Forged

fibro forged TRADE MARK **SOCKET SCREWS**

THE HOLO-KROME SCREW CORP. HARTFORD, CONN., U. S. A

SHOCK TROOPS

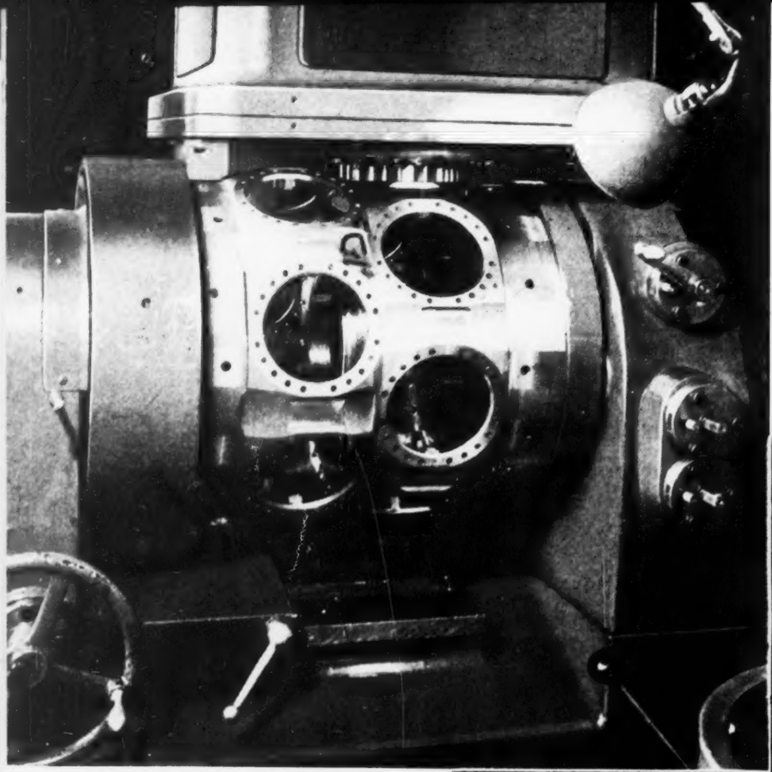
OF PRODUCTION

If turret lathes, drill presses and milling machines are the heavy artillery of production . . . reamers, drills and cutters are the shock troops upon which the success of the drive depends. So put only top quality cutting tools at the workhead. Use MORSE tools to get your production drive under way . . . and keep it going strong.

MORSE

TWIST DRILL AND MACHINE COMPANY
NEW BEDFORD, MASS., U. S. A.

NEW YORK STORE: 130 LAFAYETTE ST. - - - - - CHICAGO STORE: 570 WEST RANDOLPH ST.



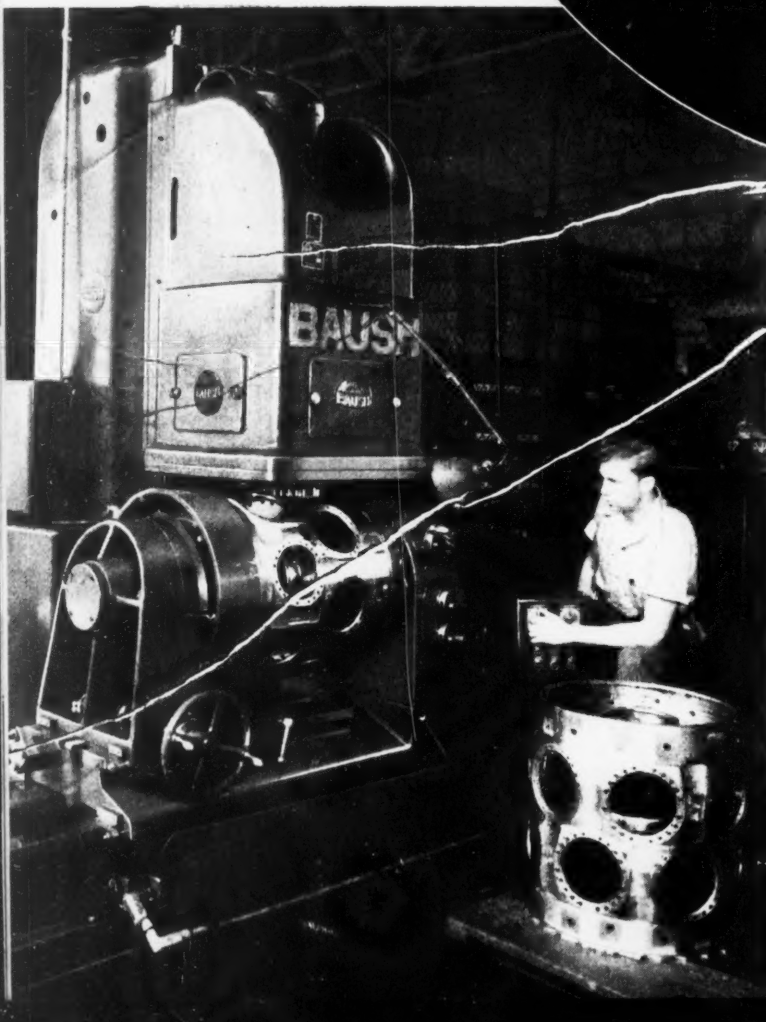
A Few Features of the

BAUSH

Back Counterboring Machine

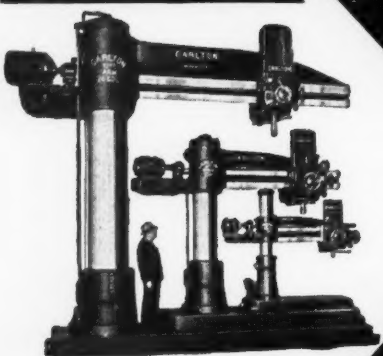
Fully hydraulic. Electrically controlled by solenoids. Semi-automatic operation. Complete push-button control. Sturdily constructed base includes coolant sump and coolant trough. Ways compensated for wear by bronze taper wear strip.

BAUSH
Back Counterboring 280 Holes in WRIGHT Cyclone Engine Crankcases in 50 Minutes with
BAUSH
Back Counterboring Machine



Baush Engineering efficiency is again evident in this aircraft job. The action photographs show how this machine back counterbores simultaneously the 20 hold down screw holes in one cylinder pad on a Wright Cyclone Engine crankcase. The operation is repeated on the remaining 13 cylinder pads—*the whole crankcase being completed in 50 minutes!* When you consider that the material is alloy steel, and that exactly the same operation required 400 minutes for completion by previous methods, then this job is certainly outstanding. Note the unique holding fixture, which allows, by indexing, the back counterboring on each of the 7 pads in one row; a rack and pinion unit traverses the work so that the second row is quickly placed in position for indexing. Details and features of Baush High-speed Precision Equipment will be sent upon request to responsible executives.

BAUSH MACHINE TOOL CO.
SPRINGFIELD, MASS., U. S. A.



CARLTON

» Low hung drive to spindle—for accurate, vibrationless operation . . . All power-driven parts running in oil—insures quiet operation at all speeds . . . Concentrated and conveniently located controls—speeds up operation . . . Constructed on unit principle with carefully designed reinforcements. Write for full description of Carlton All Ball Bearing Radials.

THE CARLTON MACHINE TOOL CO., Cincinnati, O.

RADIALS

ACCURATE PROFITABLE SMALL PART PRODUCTION

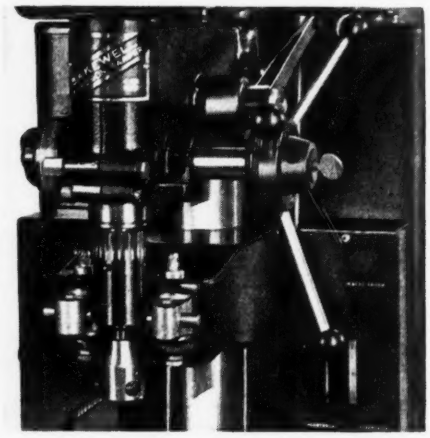
WALTHAM
TRADE MARK
REGISTERED U.S. PAT. OFF.

PRECISION THREAD MILLER

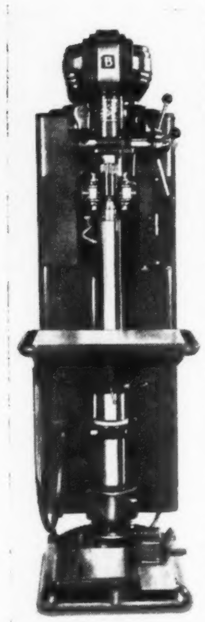
Combine economy, speed and precision in the production of small threaded parts! The Waltham Precision Thread Miller can be operated by unskilled labor on toolroom jobs or production. It can be set up to cut threads of all types including, by using a special cutter head, many internal threads. Write for bulletin giving full details of Waltham Precision Thread Millers, Gear Cutters and other small automatic machines.

WALTHAM MACHINE WORKS
Newton Street, Waltham, Mass.
Makers of Small Thread Millers, Gear Cutters and other Small Automatic Machines

PRECISION TAPPING



for TANKS GUNS AIRCRAFT ENGINES



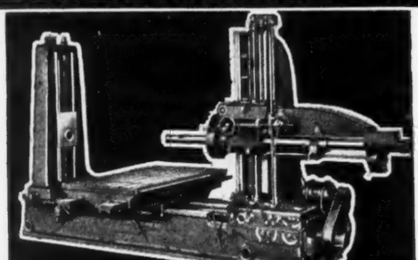
PRECISION THREADS

Right Hand	Left Hand
External	Internal
Class 3	Class 4

Bakewell Precision Tapping Machines produce perfect threads, without lead error, from soft plastics to chrome moly steels. Quantity is not sacrificed. Tap breakage reduced to a minimum by its special clutch with variable torque regulation, rejects and spoilage are negligible. They stand up under the hardest, continuous service. Used by aircraft engine and automotive manufacturers, arsenals and navy yards, tank builders, and machine gun and firearms makers. Write for full details.

BAKEWELL MFG. CO.
2427 E. 14th St., Los Angeles, Cal.

UNIVERSAL
HORIZONTAL BORING MACHINES



UNIVERSAL BORING MACHINE CO., HUDSON MASS.

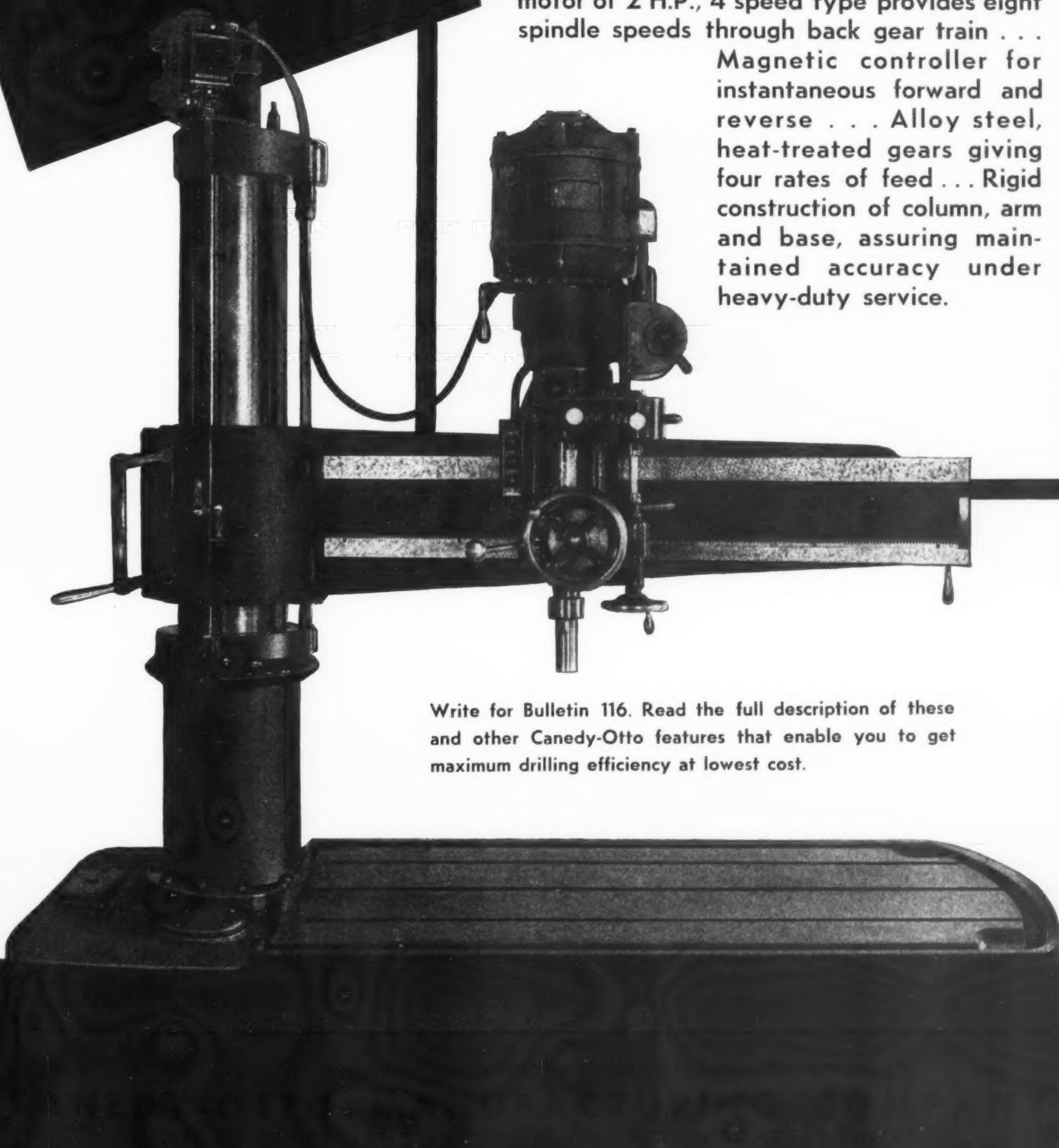
LUCAS "PRECISION"
Horizontal Boring, Drilling and Milling Machine
THE LUCAS MACHINE TOOL CO.
NOW AND ALWAYS OF
CLEVELAND, OHIO, U.S.A.

LELAND-GIFFORD-COMPANY WORCESTER MASS. U.S.A. MACHINE TOOLS-CRANK SHAFTS

Drilling and Tapping Machines
(Automatic and Semi-Automatic)
LELAND GIFFORD CO.
WORCESTER, MASS.

8 Speed Motor Spindle Radial Drill

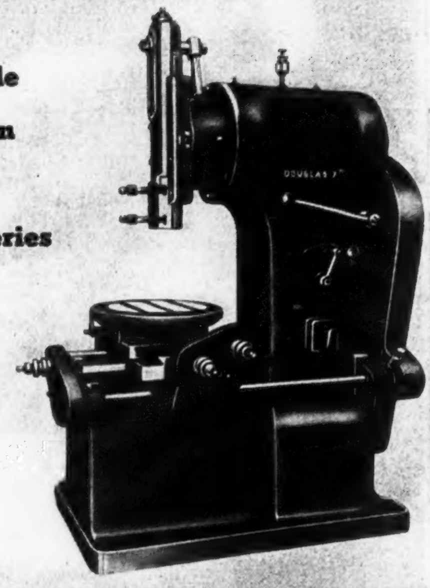
Increase your radial drilling capacity—at low cost! Get all the advantages of large and expensive radial drills, and in addition, the following Canedy-Otto features: Spindle motor of 2 H.P., 4 speed type provides eight spindle speeds through back gear train . . . Magnetic controller for instantaneous forward and reverse . . . Alloy steel, heat-treated gears giving four rates of feed . . . Rigid construction of column, arm and base, assuring maintained accuracy under heavy-duty service.



Write for Bulletin 116. Read the full description of these and other Canedy-Otto features that enable you to get maximum drilling efficiency at lowest cost.

DOUGLAS
UNIVERSAL SLOTTER 7

Large scale production ensures quick deliveries



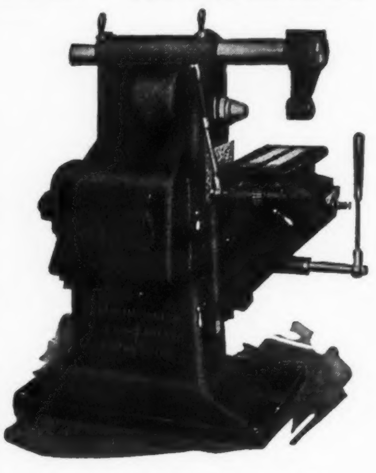
DOUGLAS MACHINERY CO., INC.
150 Broadway, New York, N. Y.

FREW
No. 3 HAND MILLER

"Big Machine" Efficiency on Small Jobs

Rugged gearing, extra wide bearing surfaces, ample power give Frew Hand Millers "big machine" efficiency on small jobs, on short runs, on high production operations.

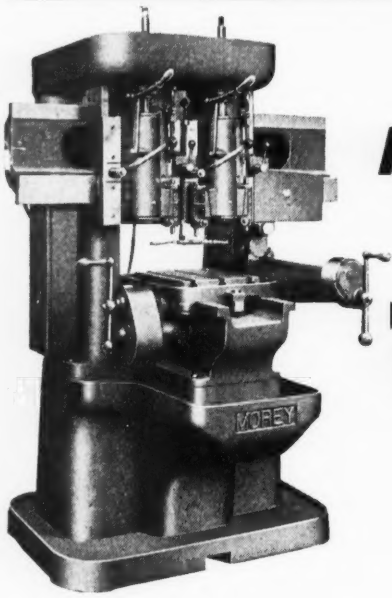
$1\frac{1}{2}$ H.P. variable speed motor mounted in base with correct size gearing gives exactly the spindle speeds suited to small work. Write for catalog showing this and other Frew Hand Millers and Tapping Machines.



THE FREW HAND MILLER

Table size, 20" x $5\frac{1}{8}$"; swing under overarm, 13". Spindle of high-grade heat-treated steel, ground to size and mounted on Timken bearings.

THE FREW MACHINE CO.
132 W. Venango St. Philadelphia, Pa.



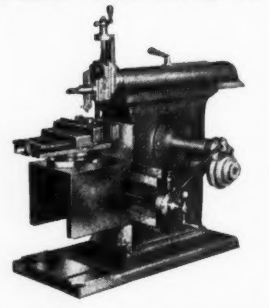
MOREY
No. 12M
HIGH SPEED VERTICAL PROFILER and MILLER

Production of interchangeable parts requiring milling of any contour or outline can be materially speeded up by this Profiling and Milling Machine.

Ask for Circular No. 680-A

MOREY MACHINERY CO., INC.
410 Broome Street New York, N.Y.

This Semi-Finished 10" SHAPER
Yours for only $175. Complete with VISE



Perfectly designed, shop tested, trouble-proof construction. Exceptionally efficient. Will stand severest service. Quickly and easily adjusted. Experienced machinists readily recognize this LEWIS SHAPER as being an excellent buy for only $175.00 including all materials, blueprints and LEWIS 7" VISE castings.

Send today for complete specifications and Catalog of Lewis Products.

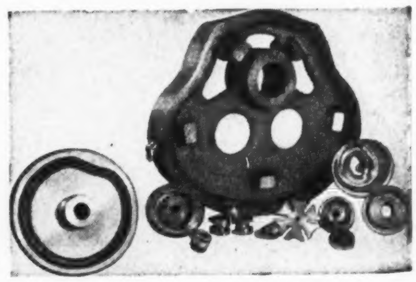
LEWIS MACHINE TOOL COMPANY
P. O. Box 116, Sta. A, Dept. X-8, Los Angeles

CUT TO
CORDER

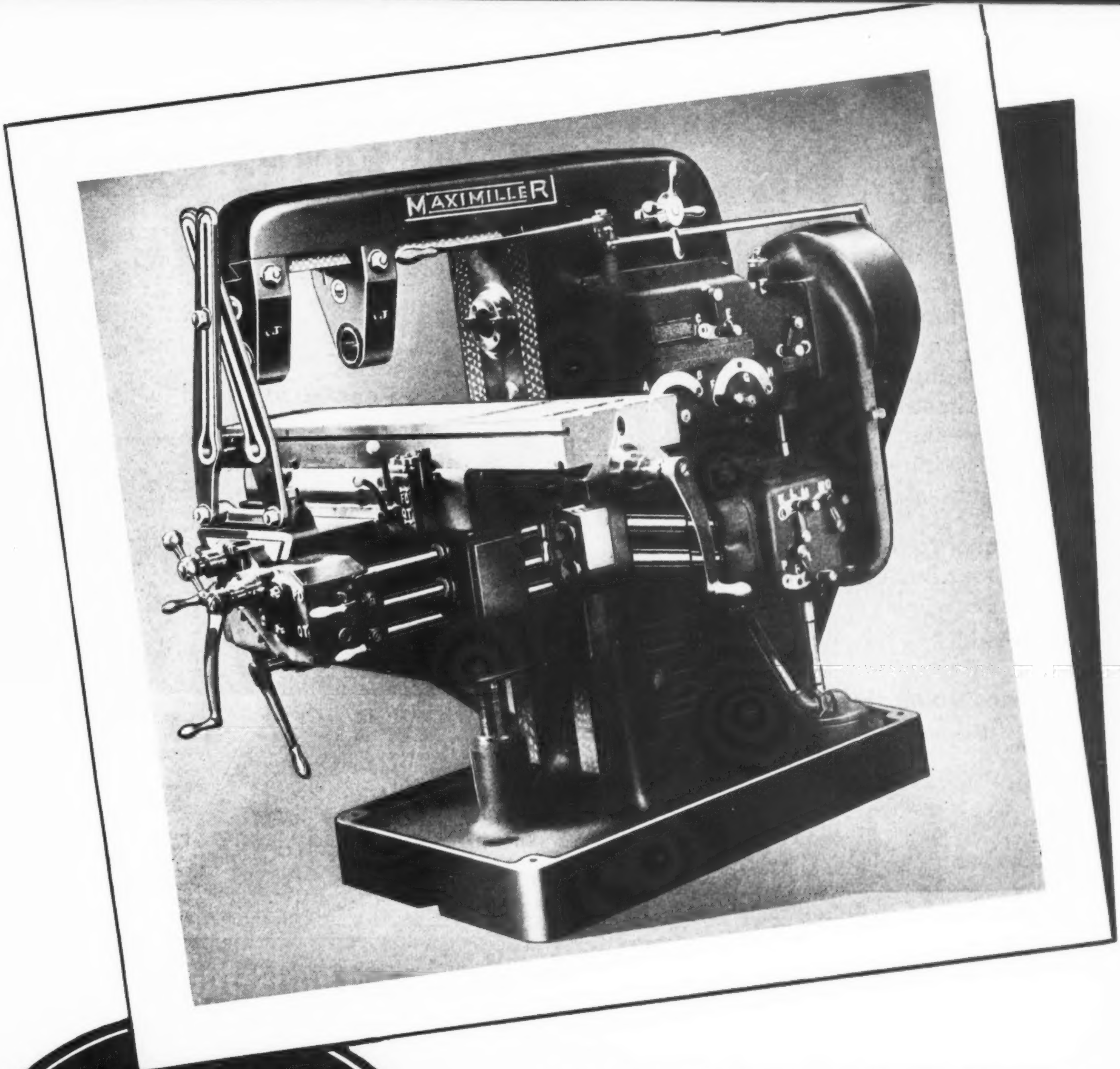
ALL STYLES
ANY SIZE
UP TO 50" DIA.

MALSO
GENEVA
MOTIONS

SEND BLUEPRINTS FOR PRICES



KUX-LOHNER MACHINE CO.
2147 LEXINGTON ST. CHICAGO, ILL.



KEMPSMITH
MAXIMILLER
delivers the desired
FLEXIBILITY and PRECISION
for
Aircraft and
Defense work

The Kempsmith Horizontal Maximiller—built in both plain and universal types—and the Vertical Maximiller are most desirable for Aircraft and Defense production calling for a machine which combines generous power with flexibility and precision. These machines have the features and the operating conveniences which make them particularly adaptable for both light and heavy manufacturing operations.

The Kempsmith light type geared head machine is ideal for handling the many jobs where small parts call for the performance of milling operations. Write for full information regarding these and other types of Kempsmith Milling Machines.

OTHER KEMPSMITH PRODUCTS

DIVIDING HEADS — HEAVY DUTY VERTICAL ATTACHMENT — HIGH SPEED UNIVERSAL ATTACHMENT — SLOTTING ATTACHMENT — VISES — ARBORS — ROTARY TABLES

THE KEMPSMITH MACHINE COMPANY
MILWAUKEE, WISCONSIN

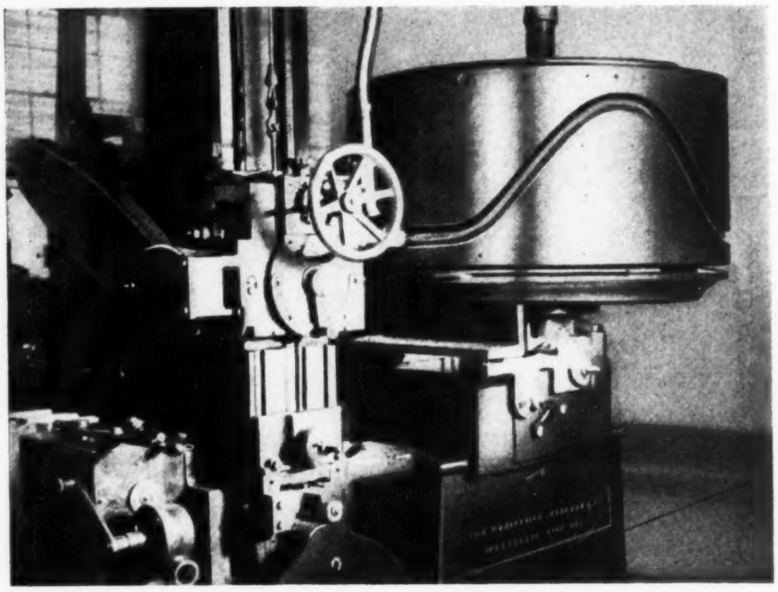
ADDRESS ALL COMMUNICATIONS TO THE FACTORY AT MILWAUKEE, WISCONSIN

Put Us on the BIG Jobs!

Don't tie up production with big, difficult cam-making jobs! We are equipped to make cams—and cams only. Our facilities enable us to handle unusual cam-milling assignments speedily and accurately—the design and manufacture of individual large cams or quantities of smaller ones.

Conserve man- and machine-power! Remember Rowbottom for Cams when plant capacities are taxed to the limit.

The Rowbottom Machine Co.
Waterbury, Conn., U. S. A.

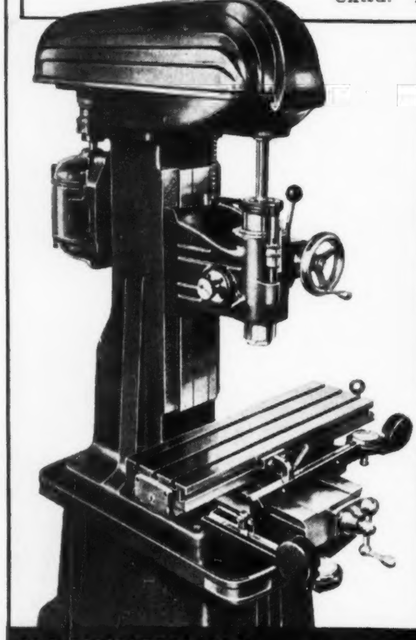


Cast iron barrel cam 48" outside diameter, 45" inside diameter with a 23½" face. Throw of cam is 17" and groove is 2½" in diameter, milled full depth.

—Rowbottom for Cams—

New *Vernon* Vertical Mill and Jig Borer

The **ONLY MACHINE** in the **LOW PRICE FIELD** on which Jig **BORING** Equipment can be furnished as a standard extra. Prompt Delivery.



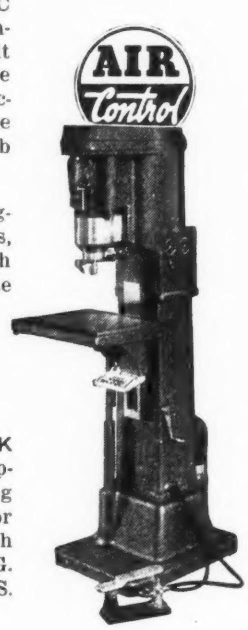
Equipped with **Dial Indicators** and **Measuring Rods**, the **Vernon** is invaluable for smaller **jig boring operations.**

MACHINERY MANUFACTURING COMPANY
1915 E. 51 St., Vernon, Los Angeles, California
Vernon Line of HORIZONTAL MILLS, VERTICAL MILLS & JIG BORERS, 11" SHAPERS & GRINDERS
2090

Leads the Field TWO WAYS!

IN ACCURACY. If *precision* tapping is your problem, the Haskins Type C Tapper is your answer. So finely engineered is this sensitive machine, it is now being used in the manufacture of *micrometers*—and *doubling* production, too! Class 3 and 4 fit are maintained with ease when the job requires it.

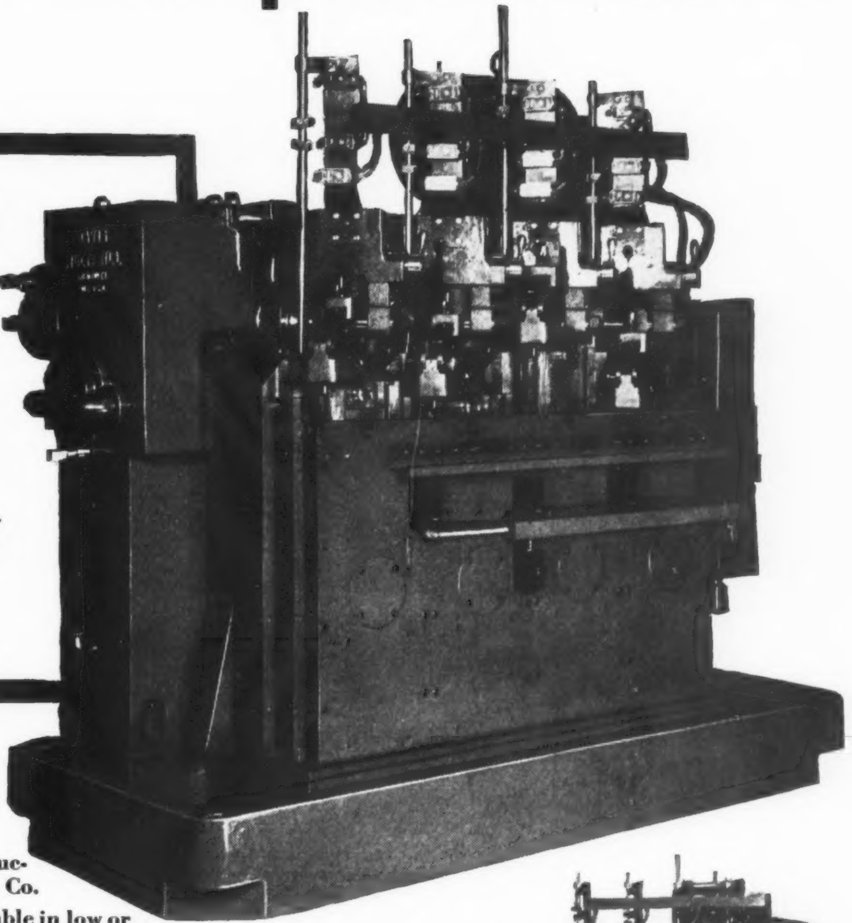
IN SPEED. Easily adaptable to magazine, dial and hopper feed operations, this *air-controlled* tapper goes through its cycles automatically—as fast as the operator can load and unload the work. And that's *all* he has to do! *Of course*, tap breakage and tapping costs go *down*—tapping production goes sharply *up!*



SEND FOR FREE BOOK illustrating Haskins Tappers at work and giving complete specifications for the three capacities in which Type C is available. R. G. Haskins Company, 617 S. California Ave., Chicago.

HASKINS
R. G. HASKINS CO.

The Davis & Thompson Multimill



A compact, high speed, accurate machine tool for plunge cut, straddle mill and similar work

Versatile — built with many unusual features of automatic control and performance — the Davis & Thompson Multimill is another example of specialized development of high production machinery by Davis & Thompson Co.

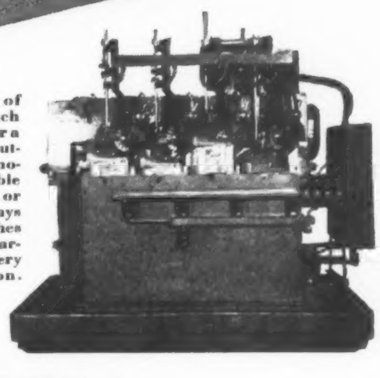
The cycle of operations includes: with table in low or down position, work is loaded into fixture and start button pressed. Table now rapidly advances by hydraulic means to a predetermined point, contacting a limit switch and slowing down to a predetermined feed. At this point cutters contact work which is automatically fed through cutting area. Limit of table travel is 8 inches.

When table reaches end of cut, contact with return limit switch returns table to loading position where it is stopped by another limit switch . . . Separate pumps operate the independent tables in this machine; fixtures, as required by the work, may be either hand or automatically operated . . . Individually controlled motors, control switches for each station, a master switch for the entire machine — provide positive, flexible control.

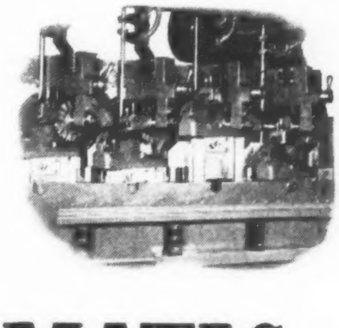
Placed at an angle of 37½°, the heads of the Davis & Thompson Multimill facilitate loading and provide ample space for the work —work can overhang table without interfering with next station. Tables have micrometer adjustments, fixture can be moved relative to cutter, spindle has 2½ inch lateral adjustment.

Machine is ball bearing equipped throughout including Timken Bearing spindles. Write for complete information on this and the entire Davis & Thompson Rotomatic line.

DAVIS & THOMPSON COMPANY
Milwaukee, Wis., U. S. A.



Showing close-up of fixtures. Eight inch diameter cutters or a 6 inch wide form cutter can be accommodated. Slides of table take side pressure or torque of cutter; ways run to within 2 inches of center line of arbor—making for very rigid construction.



Front view of Davis & Thompson Multimill — set for milling the fork slot into a rod from solid material.

DAVIS ROTOMATIC

HIGH PRODUCTION MACHINERY

Sunnen Precision Honing Aids Defense Production—

In Time . . . .
No set up or locating time; removes stock rapidly; produces super-smooth finish.

In Dollars . . .
Low in initial cost (basic machine price only $195); economical to operate; requires only semi-skilled labor.

In Man Hours
Saves skilled labor and training time—any intelligent young man can learn to do precision work in 24 hours.

In Power . . .
Uses only 1/3 h.p. — relieves internal grinders and other machine tools for other work.

Throughout the metal working industry the Sunnen Precision Honing Machine is being used by scores of plants working on defense contracts. One manufacturer is using 22 machines—several are using 14—half a dozen using 8 or more.

This practical, inexpensive machine solves five important problems:

1. Corrects errors of out of roundness and taper produced by previous operations

2. Produces super-smooth surface finishes.

3. Finishes internal diameters to close tolerances both as to roundness and straightness.

4. Maintains alignment established by previous operations.

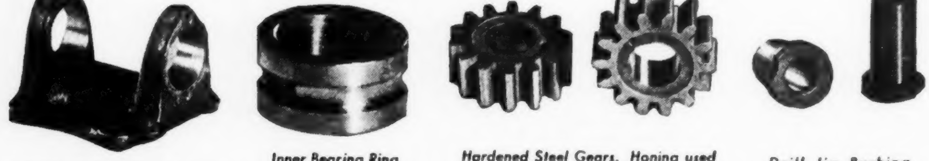
5. Provides simple, low cost, production method of duplicating sizes accurately.

Accuracy within .0001" *guaranteed!* Can be set up and ready to go in less than a minute! Range — internal diameters from .185" to 2.400".

Write at once for an 8-page bulletin—or if you prefer a sales engineer will be glad to call and demonstrate in your plant on your job what this machine can do for you!

SUNNEN PRODUCTS COMPANY
7940 Manchester Avenue, St. Louis, Missouri
Canadian Factory, Chatham, Ontario

Typical Uses



"Strict alignment maintained between two holes."

Inner Bearing Ring "Accurately removes last 'tenth' of stock."

Hardened Steel Gears. Honing used to remove any distortion after hardening and to selectively size the gears to uniform diameters.

Drill Jig Bushing "Increases sales appeal of product."

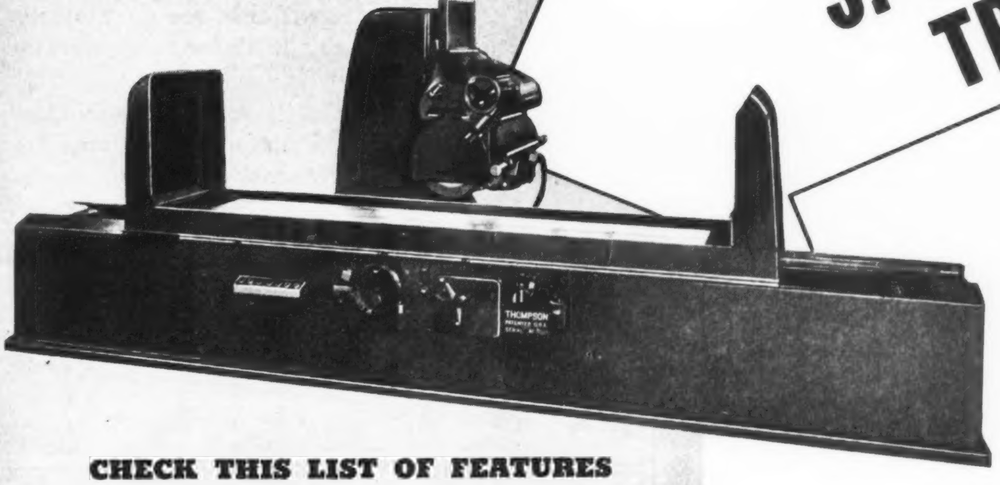
SUNNEN Precision Honing Machine

THOMPSON FEATURES

POINT THE WAY TO MODERN, LOW-COST PRECISION GRINDING

For Instance—

3. WHEEL TRUING



Thompson Wheel Truing Consumes No Time . . . Controlled To Close Limits

CHECK THIS LIST OF FEATURES AGAINST ANY OTHER GRINDER:

- Automatic Down Feed
- Hydraulic Rapid Traverse (Pat'd)
- Automatic Wheel Truing
- Power Elevation
- Rectangular Column Ways
- Telescope Piping
- Instant Central Controls
- Anti-Friction Elevating Nut
- Massive Machine Beds
- Hydraulic Power Unit
- Wheel Head Slide Wipers
- Automatic Spark-out Control

ALSO SPECIAL ATTACHMENTS

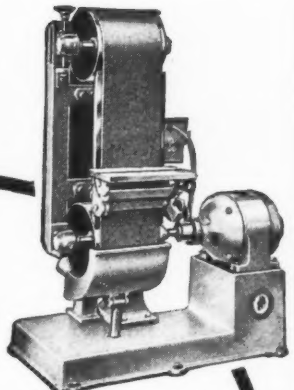
Consistent with the Thompson design for low cost precision Grinding, the wheel Truing device is actuated as the wheel head moves to its rear position. Truing is accomplished by means of a slow, continuous feed in which the wheel face passes over the truing tool to form an accurate wheel face with maximum efficiency. The operation consumes no time, and controls are provided for working to very close limits of accuracy. This Thompson Feature is but one of many which promote the greatest possible economy without the least sacrifice of precision. Full specifications in latest Bulletin. Write for your copy today.

THE THOMPSON GRINDER CO.

Completely Covering all Normal Ranges of Surface Grinding Requirements

SPRINGFIELD, OHIO, U. S. A.

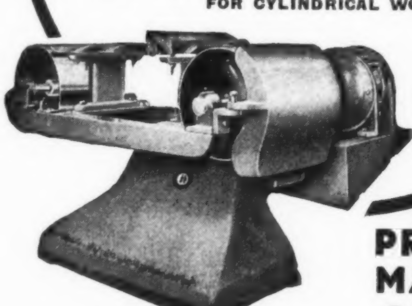
PEERLESS SURFACING MACHINES



Rapid!

Use Peerless Machines for rapid, inexpensive surfacing of metals, woods or plastics! Quickly changed belts give uniform speed abrasive or polishing action that results in an accurate, straight-grain finish. Built in horizontal or vertical models in 9", 14" and 20" belt widths with dynamically balanced drums and self-aligning ball bearings. Also made in 4" and 6" bench models.

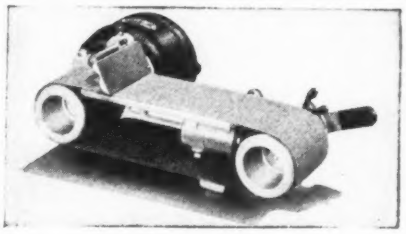
ALSO CENTERLESS FEED POLISHING MACHINES FOR CYLINDRICAL WORK



PRODUCTION MACHINE CO.
Greenfield, Mass.

NOW!

An Inexpensive
ABRASIVE BAND GRINDER—



"Built Like a Machine Tool"

The Hormel-M Grinder is sturdily built with a supporting leg under the grinding table to eliminate vibration and tipping due to pressure on belt. Ball bearing throughout, equipped with Alemite lubrication, complete with grease gun. *Write for illustrated folder on this and other styles and sizes.*

HORMEL-M GRINDER
WALLS SALES CORP., 96 Warren St., New York, N.Y.

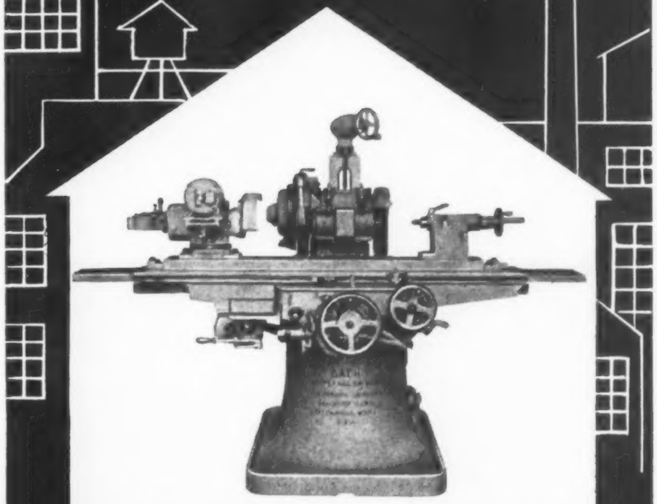
ABRASIVE Surface Grinders

QUALITY — DURABILITY
ACCURACY — ECONOMY

WRITE FOR PARTICULARS

ABRASIVE MACHINE TOOL CO.
EAST PROVIDENCE, R. I.

It's a whole Grinding Shop in itself!



BATH

FULL UNIVERSAL PRECISION
GRINDER
FOR TOOL ROOM AND SMALL LOT WORK

Here is a single, flexible, precision grinding machine so versatile that it will handle external, internal, surface, tool spur gear and other classes of grinding. Shifts from job to job easily and quickly. A real convenience and money saver for maintenance shops and tool rooms. Conserve time, floorspace and money on small lot work with a single machine that performs every operation required of an entire grinding department in many plants. Large new folder, profusely illustrated, gives all details. Free to executives requesting it on business letterhead. Write for your copy today.

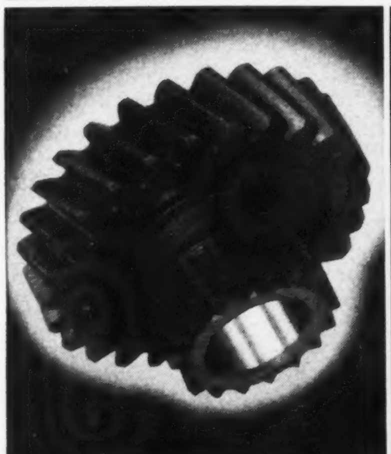
FITCHBURG

GRINDING MACHINE CORP.
1608 FALULAH RD., FITCHBURG, MASS., U.S.A.

MICROMATIC HYDROHONER
with
AUTOMATIC MICROSIZE

Generates

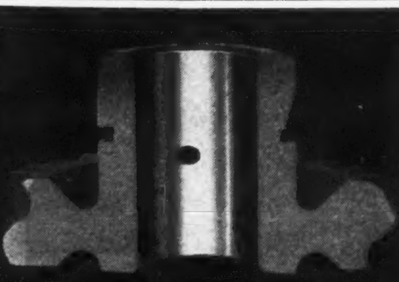
Uniform Size within .0002" to .0005"
Bore Accuracy within .0001" to .0002"
Removes Sufficient Stock for Above Results

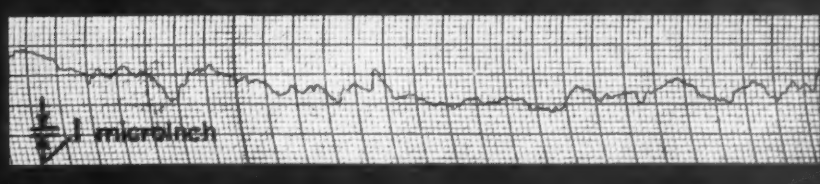


Automatic Second Speed Gear

In forged steel second speed gear bores 1.062" I.D. x 1.886" long, and Rockwell C 49-54 hardness; total error up to .001" is corrected by removing .001" to .0015" stock following grinding, generating uniform size within .0005", geometric accuracy within .0001" to .0002" and surface smoothness accuracy within 1.8 to 2.5 microinches root-mean-square—all at the rate of 240 bores per hour on this two spindle machine.

Generates any desired type and degree of surface smoothness



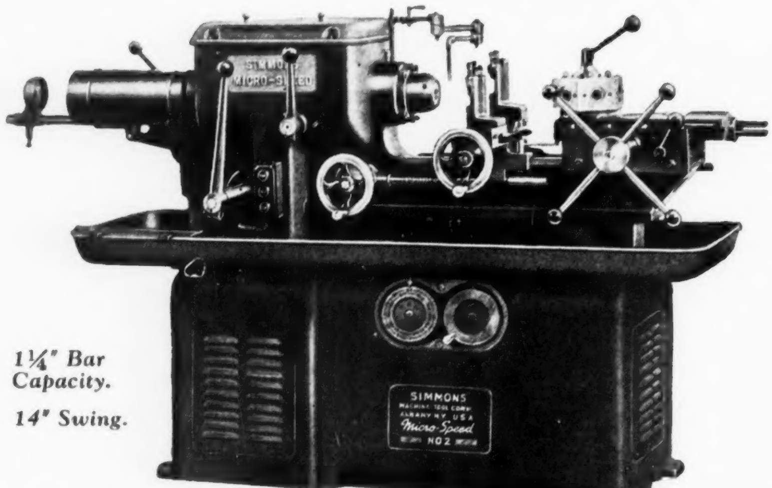


Circumferential (root-mean-square)—1.8 to 2.5 millionths of an inch

MICROMATIC HONE CORPORATION
1345 E. Milwaukee Ave. **Detroit, Michigan**

"EXTREMELY SATISFIED!"

—Writes Fairchild Aircraft, Ltd., Regarding the Simmons Turret Lathe.



1¼" Bar Capacity.

14" Swing.

"WE are operating 8 SIMMONS MICRO-SPEED TURRET LATHES," writes N. F. Vanderlipp, general manager of Fairchild Aircraft Limited, Longueuil, Quebec. "They are doing well and we are extremely satisfied with their performance. They are being used in the manufacture of the Bolingbroke Bomber."

Countless other prominent firms engaged in American and Canadian defense production are outspoken in their satisfaction over the performance of this sturdy new tool.

Besides embodying every modern facility for rapid, accurate output, it features the SIMMONS MICRO-SPEED DRIVE, which offers a range of spindle speeds up to 1500 RPM. Note the Selector Dial Control in the center of the new cabinet base for selecting the desired speed instantly.

Another important factor is that our delivery schedules are EXCELLENT!

NEW CABINET BASE AND SPINDLE BRAKE

Spindle mounted on Timken Precision Tapered Roller Bearings. Levers within immediate reach of operators. Head cast solid with bed. Spindle brake stops and locks the spindle. Plain or Back-Geared.

SIMMONS MACHINE TOOL CORP.
1600 NORTH BROADWAY
ALBANY, N. Y.

New York Office: 149 BROADWAY

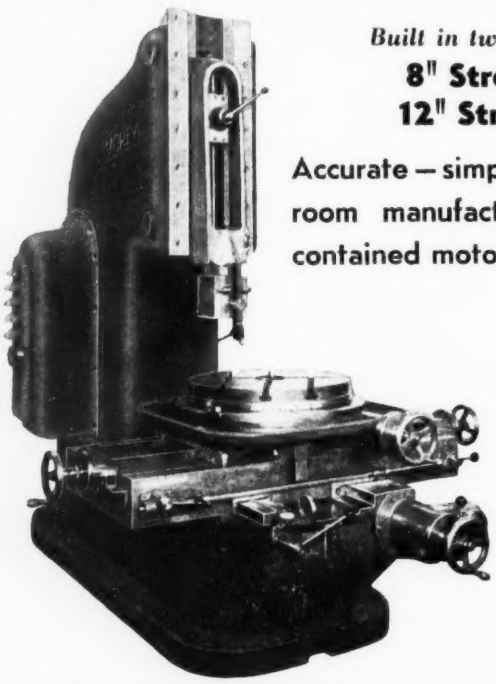
MOREY
VERTICAL SHAPERS

Built in two sizes:

8" Stroke

12" Stroke

Accurate—simple for toolroom manufacturing. Self-contained motor drive.



Ask for Circular No. 726

MOREY MACHINERY CO., INC.
410 Broome Street New York, N.Y.

BALDOR
Special GRINDER for
CARBIDE TOOLS

Precision-built for accurately and quickly sharpening Carbide Tools. Sturdy ½ H.P. Heavy Duty Ball-bearing Reversible Motor. Large, adjustable tool-rest tables.

New Low Price

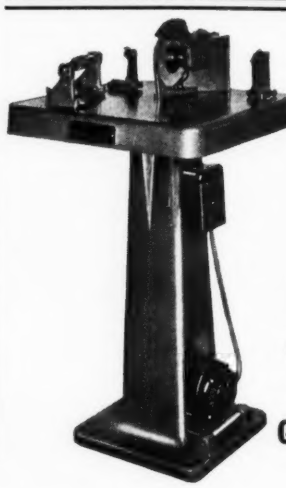
PRICE, complete with wheels and accessories

$84.00

Write for Bulletin No. 300

BALDOR ELECTRIC CO.
4400 Duncan Ave., St. Louis, Mo.

1 Year Guarantee



The BARNES
MOTOR DRIVEN PRECISION CUTTER GRINDING MACHINE

For Precision Grinding Formed Milling Cutters

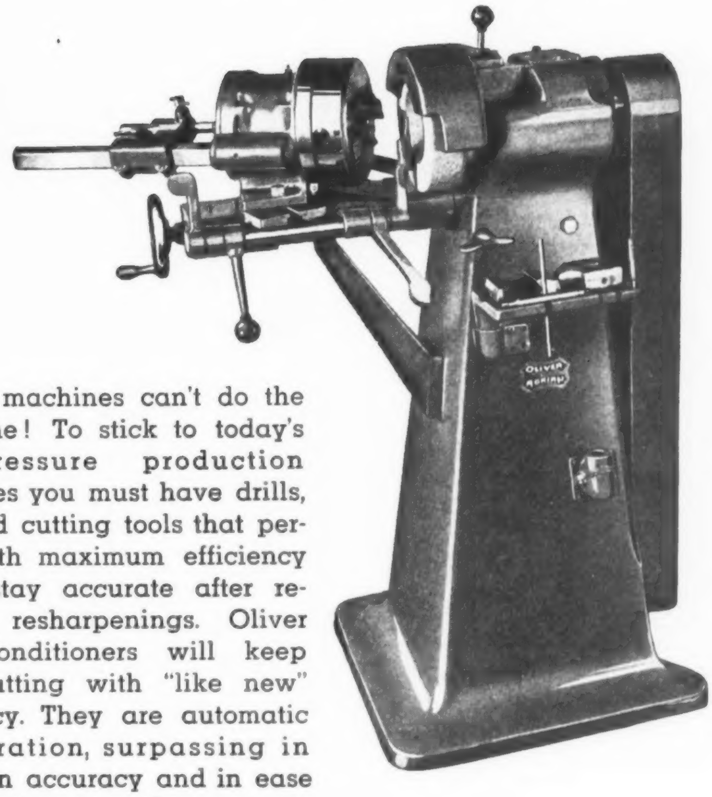
USED IN THE MANUFACTURE OF RIFLES, PISTOLS, ETC.

Write for bulletin giving complete description

GENERAL MACHINERY CORP.
140 Federal St., BOSTON, MASS.
Telephone Liberty 4826

Boost Your Production

WITH OLIVER-CONDITIONED DRILLS AND CUTTERS



UNIVERSAL TOOL and CUTTER GRINDER

With a few simple fixtures, grinds face mills, slitting saws, end mills, angular cutters, slab mills, spot facers, formed cutters, reamers, gear cutters, etc. Produces accurate clearances by direct reading—uniform teeth, correct angles and straight cutting edges that mean better service.

•

Don't Neglect Your Toolroom It's the Backbone of Production!

Modern machines can't do the job alone! To stick to today's high-pressure production schedules you must have drills, taps and cutting tools that perform with maximum efficiency—that stay accurate after repeated resharpenings. Oliver Tool Conditioners will keep tools cutting with "like new" efficiency. They are automatic in operation, surpassing in speed, in accuracy and in ease of operation even the most expert hand-controlled methods.

Equip your toolroom—as well as the rest of your plant—for production. That is where schedule-maintaining efficiency starts! Let us study the types and quantities of tools you use and recommend the correct Oliver Tool Conditioners to keep production on schedule—drills that cut with minimum effort, cutters that cut, taps and other tools that maintain their original accuracy as long as they last.

OLIVER INSTRUMENT COMPANY
1410 EAST MAUMEE ST.
ADRIAN MICH.

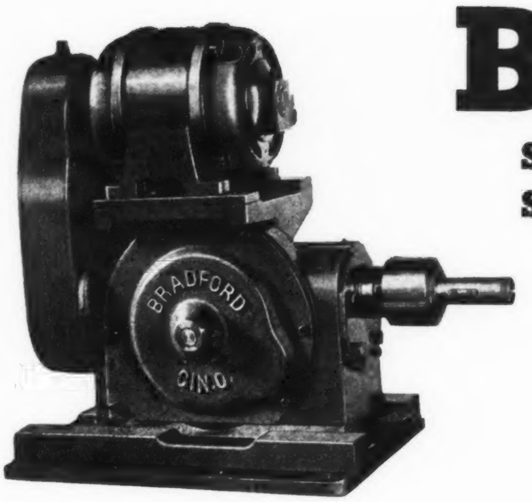
No. 510 DRILLPOINTER

Automatic operation produces the patented Oliver point and variable clearances. Holds all drills from 1/4" to 3" in diameter, and produces any point angle from 82 to 160 degrees. Ball bearing mounted main shafts and TIMKEN equipped grinding spindle assure ease of operation and maintained accuracy.

OLIVER OF ADRIAN PRODUCTS

Oliver OF ADRIAN

AUTOMATIC DRILL GRINDERS—TOOL AND CUTTER GRINDERS—DRILL POINT THINNERS—TEMPLATE TOOL GRINDERS—TAP GRINDERS—FACE MILL GRINDERS, DIEMAKING MACHINES



BRADFORD

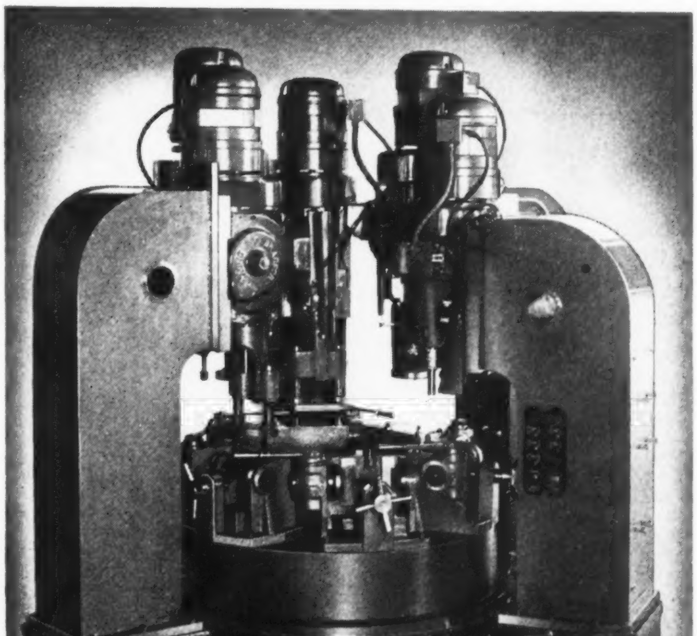
SELF-CONTAINED UNIT TYPE
SINGLE OR MULTIPLE SPINDLE

HEADS

DESIGNED FOR TOMORROW

AS WELL AS TODAY

A Bradford 5 Unit Semi-Automatic Machine with six station index table for drilling, spotfacing, reaming and tapping automobile transmission cases. Control of machine is fully electric by means of solenoid operated clutches, switches and relays. Production at 85% efficiency—240 parts per hour.



Use Bradford drilling and tapping units in any combination to get high production, quickly and at low cost. These individual, self-contained units never become obsolete —they will be as useful for tomorrow's production demands as they are for today's.

Bradford Heads come in two types, a light, high speed unit for small work and a heavy duty type for larger jobs. Both the single and multiple spindle types can be used over and over again in any combination to build special high production machines for drilling, tapping, reaming, hollow milling, spotfacing and similar operations. They may be mounted vertically, horizontally or at any angle.

Let our engineering staff show you how Bradford Unit Heads can cut costs on today's —and tomorrow's—production problems.

Precision Tools **Since 1840**

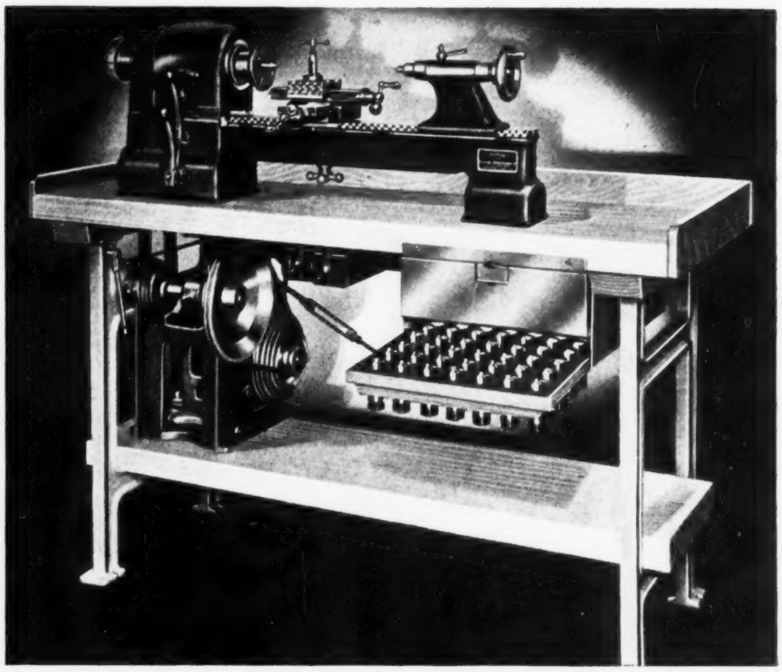
THE BRADFORD MACHINE TOOL COMPANY

657-671 Evans St. **Cincinnati, Ohio**

WE ALSO MANUFACTURE THE BRADFORD GEARED HEAD ENGINE LATHE

ELGIN

BENCH LATHE UNITS



Featuring two noteworthy improvements for operating convenience! Cap covering driving belts can be quickly removed for changing belts without dismantling the machine. Two lever control — one for low and high speeds and stopping the lathe, the other for forward, reverse and stopping spindle rotation — speeds operation. Built in 1/2", 3/4" and 1" collet capacities, 9" swing. Write for complete specifications.

ELGIN TOOL WORKS 1770 BERTEAU AVE. CHICAGO, ILLINOIS
DIVISION OF HARDINGE MANUFACTURING CO.

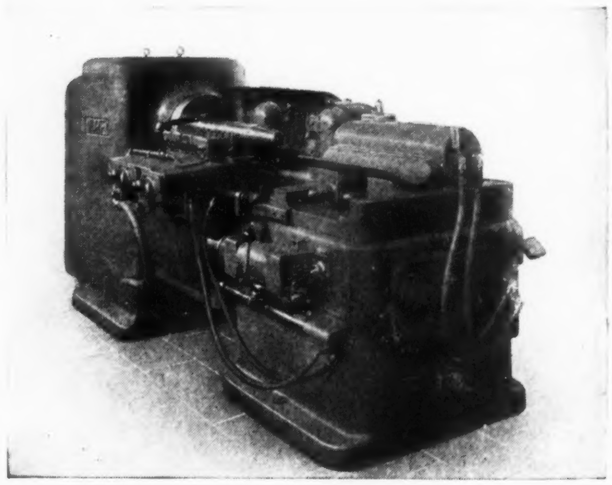
SHELDON Back Geared Screw Cutting PRECISION LATHES

1" Collet Capacity—Ball or Roller Bearing

No. BB U-1136 WQ Sheldon 11" swing, 36" between centers; pre-loaded ball-bearing spindle, hardened and ground all over, inside and out, with 1⅜" hole thru center, hand scraped bed, ways (2 V-ways, 2 flat ways), full quick change gear box, worm feed apron with power cross feed, thread chasing dial and 4-speed lever operated underneath pedestal motor drive, and telescopic taper attachment.

Write for Catalog showing complete line of Sheldon Precision Tool Room and Manufacturing Lathes, attachments, and accessories; Sheldon Arbor Presses and Sheldon Drill Press and Machine Vises.

SHELDON MACHINE COMPANY, INC.
1627 No. Kilbourn Ave., Chicago, Illinois, U.S.A.



"27" MOREY Semi-Automatic Heavy-Duty LATHE

JUST THE MACHINE FOR SHELL WORK!

Suitable for rough or finished turning shells at maximum feed. Put your shell operation on this fast powerful lathe and turn out your work at top speed up to the limit of tool capacity. Multiple tool holders can be supplied at front and rear; turret mounted on separate saddle can be used instead of tailstock. Full use of carbide tools can be taken by this heavy duty lathe.

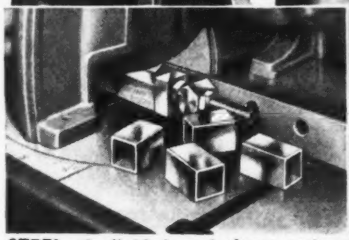
Ask for Circular No. 715

MOREY MACHINERY CO., INC.
410 Broome Street New York, N.Y.

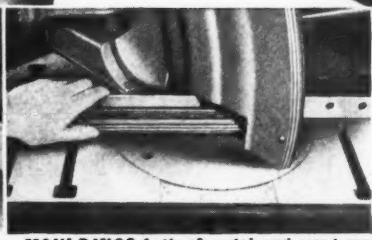
Cut "Cut-off" Costs

with this NEW Delta Abrasive Cut-Off Machine

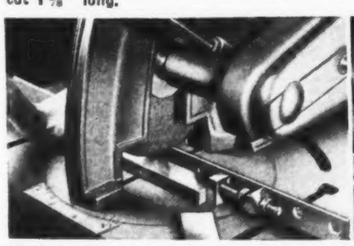
This new, powerful, accurate abrasive Cut-Off Machine—designed by Delta and built according to best engineering practices — can be used everywhere, in large shops or small, where materials have to be cut to accurate length on a production basis. It can be used for hundreds of operations now performed by costlier machines —or being done by hand at high cost. It actually creates jobs for itself—saves time and money wherever used. Best of all—it is available at about one-half the usual price of machines of this type.



STEEL of all kinds and shapes such as angles, hollow squares, channels, etc., is accurately and quickly cut—at any desired angle. Photo shows 1 ⅛" hollow shape being cut 1 ⅜" long.



MOULDINGS both of metal and wood are accurately mitered. Photo shows solid bar mouldings which will be used on new store front. Advantages of swivel table and accurate scale plate are here apparent.



TOOL STEEL when it must be cut to exact lengths as here illustrated, is easily handled on this new tool. With proper wheel, cut is clean, to exact length and easily made.

BRASS, COPPER, ALUMINUM—bars and shapes of every description up to 2 inches in diameter are "polished—cut" on the Abrasive Cut-Off Machine. It is simple to change the wheel.

Cuts Pratically Any Material

This new Delta unit has an unusually wide range of applications. It will cut speedily and accurately to exact lengths such materials as steel, cast iron, monel metal, bakelite and all plastic materials, pipe, wire, rope, stellite, tool steel, manganese steel, fibrous material such as brake linings—tile, brick, carbon, porcelain, slate, hard rubber, concrete coping and sand cores. On metal it leaves the cut with a polished surface, thus eliminating many burring and finishing operations. (Note: A Delta Cut-Off Machine with special blade is also available for cutting non-ferrous metals).

Many New Features

This improved Abrasive Cut-Off Machine is ruggedly constructed with heavy casting throughout — wide spaced Timken roller pivot bearings and double arbor sealed-for-life bearings requiring no lubrication—powerful Texrope V-Belt drive—adjustable fence—accurately machined table. It is perfectly balanced, making for easy operation—cuts material at any angle and embodies unusual safety features such as husky chip guard, belt and wheel guards. Can be used with abrasive wheels or cross-cut blade for wood. Capacity up to 2 inches diameter, or material up to 2 inches by 6 inches.

SEND FOR CUT-OFF BULLETIN giving full details and prices on the Delta Abrasive Cut-Off Machine and all accessories.

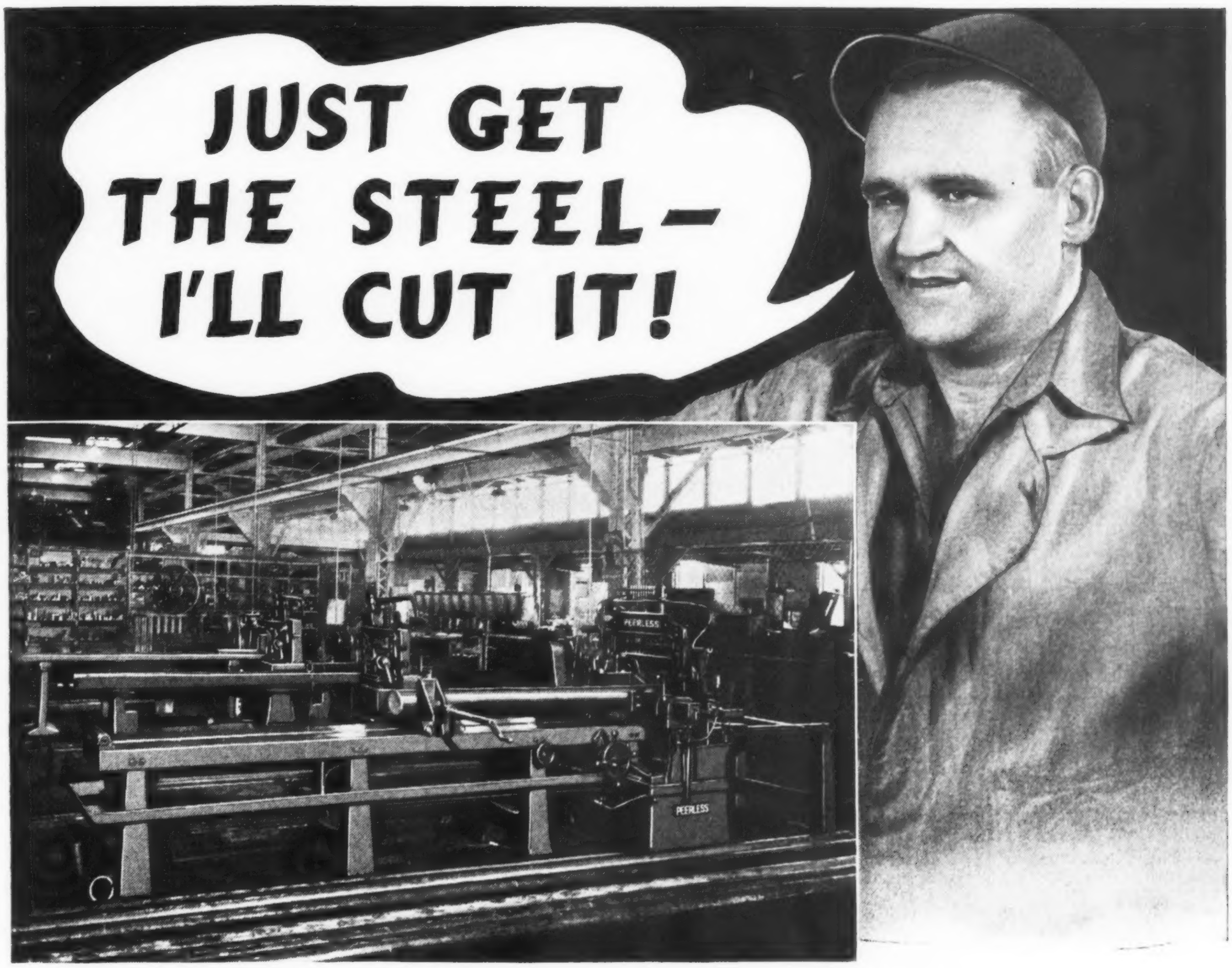
DELTA MILWAUKEE

The Delta Manufacturing Company (Industrial Division)
605-H E. Vienna Ave., Milwaukee, Wis.
Please send me special bulletin on the new Delta Abrasive Cut-Off Machine. ☐ Also send latest Delta Catalog of Machine Tools.

Name ....

Address ....

City ....
☐ Send special circular on Delta Cut-Off Machine No. 1631 for cutting non-ferrous metals.



PERFORMANCE REPORT "J"

Peerless 6" x 6" Bar Feed with full automatic, hydraulic control cuts S.A.E. 3140 bars . . . 1½" diameter . . . 16 bars nested . . . in 6 minutes, a total of 864 pieces. The same blade accurately cut 1500 sq. in. of this material.

FAST, SAFE CUTTING IS A CINCH WITH A PEERLESS!

You don't hold up other operations when you turn the work over to a good man with a Peerless. The production capacity you want — the safe, accurate, high-speed cutting you need is there for you in a Peerless. More than twenty-five years of specialized saw building has shown Peerless how to put the stuff into metal sawing machines that set the standards for metal cutting throughout industry . . . Peerless is the only saw which is equipped with the Four-Sided Saw Frame—the frame that completely surrounds the blade and work. This holds the blade with a tension and rigidity never before possible — prevents bowing, permits the blade to lift clear on every return stroke, and thereby lengthens blade life . . . All this adds up to 25% faster cutting in day-in and day-out production. We will gladly submit cutting-time estimates for your own regular or special types of metal sawing.

Peerless METAL SAWING MACHINES

PEERLESS MACHINE COMPANY, Dept. M-841, Racine, Wisconsin

Mail cutting time estimate for..........

☐ Mail catalog on Hydraulic type Saw for High Production Cutting
☐ Mail catalog covering Vertical type used for Die Block Work
☐ Mail catalog on Mechanical type Saw for production cutting
☐ Mail catalog on general utility and maintenance Saws

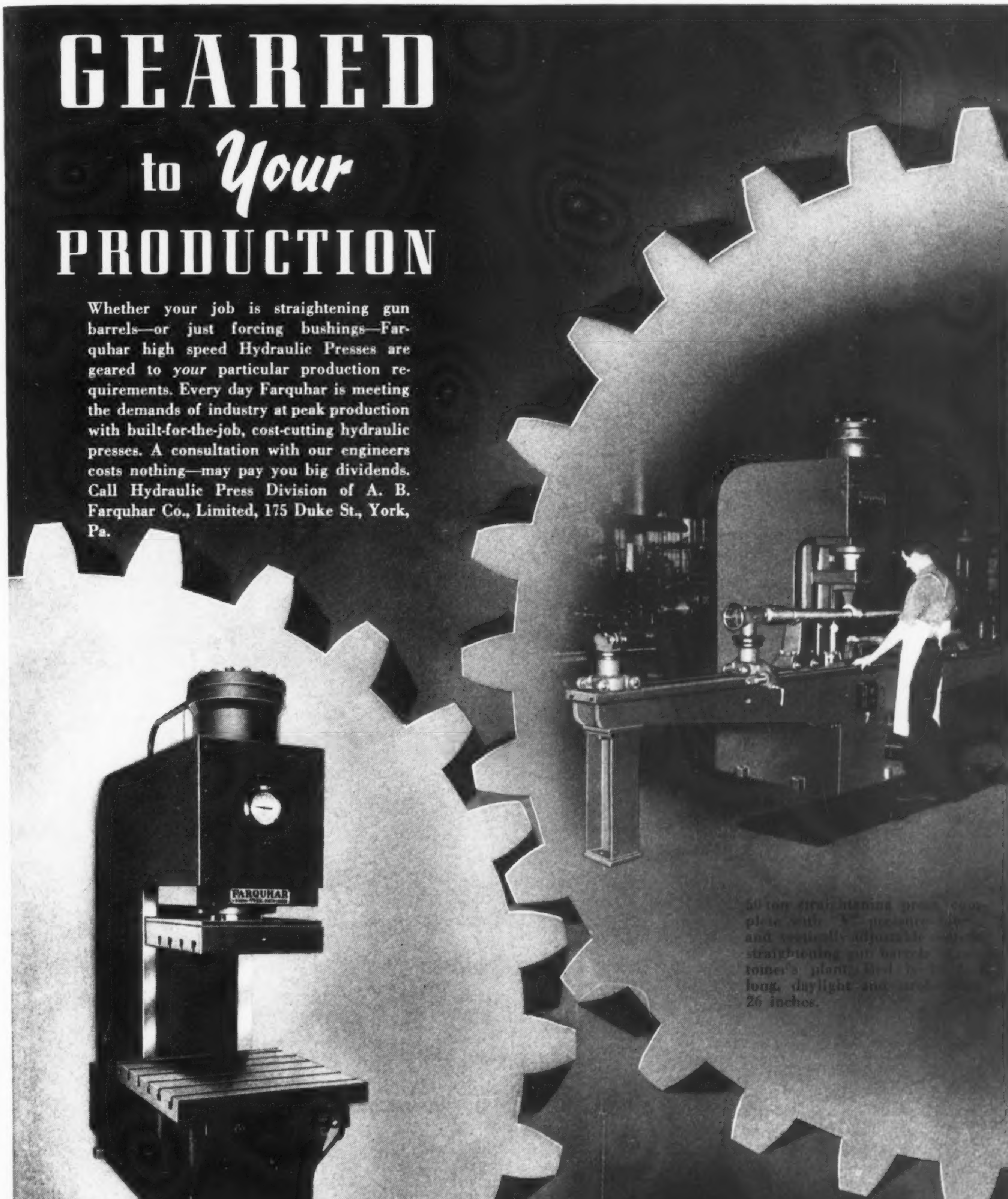
Company..........

Individual..........

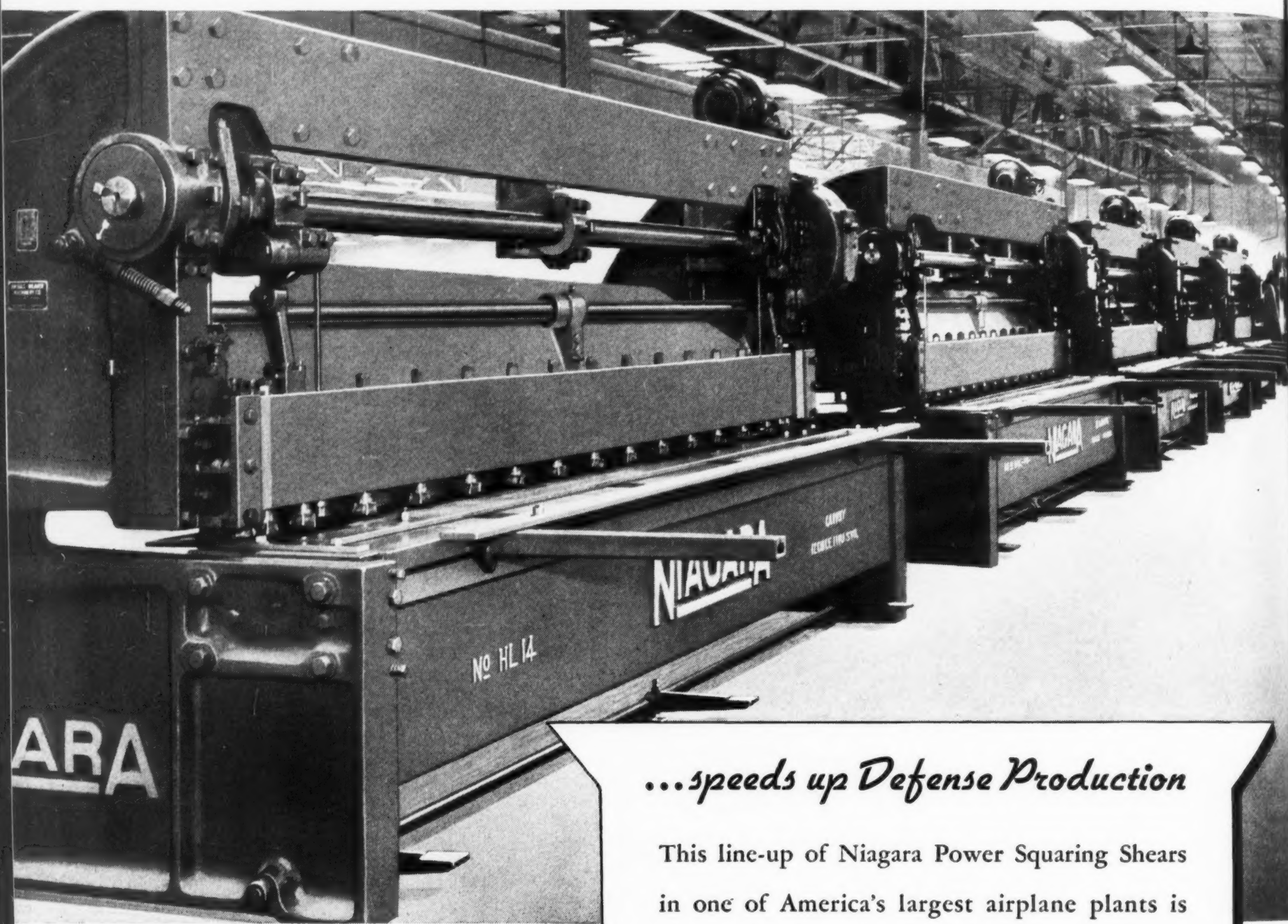
Street..........

City.......... State..........

FAST, ACCURATE CUTTING DEMANDS POSITIVE BLADE CONTROL


GEARED
to Your
PRODUCTION
Whether your job is straightening gun barrels—or just forcing bushings—Farquhar high speed Hydraulic Presses are geared to *your* particular production requirements. Every day Farquhar is meeting the demands of industry at peak production with built-for-the-job, cost-cutting hydraulic presses. A consultation with our engineers costs nothing—may pay you big dividends. Call Hydraulic Press Division of A. B. Farquhar Co., Limited, 175 Duke St., York, Pa.
FARQUHAR
65-ton self-contained, hydraulic press with 10 HP motor, 120 RPM. Bed, 36" x 36". Slide, 24" x 24". Daylight and stroke each 24".
FARQUHAR
Self contained
HYDRAULIC PRESSES

Another BATTERY OF NIAGARA POWER SQUARING SHEARS

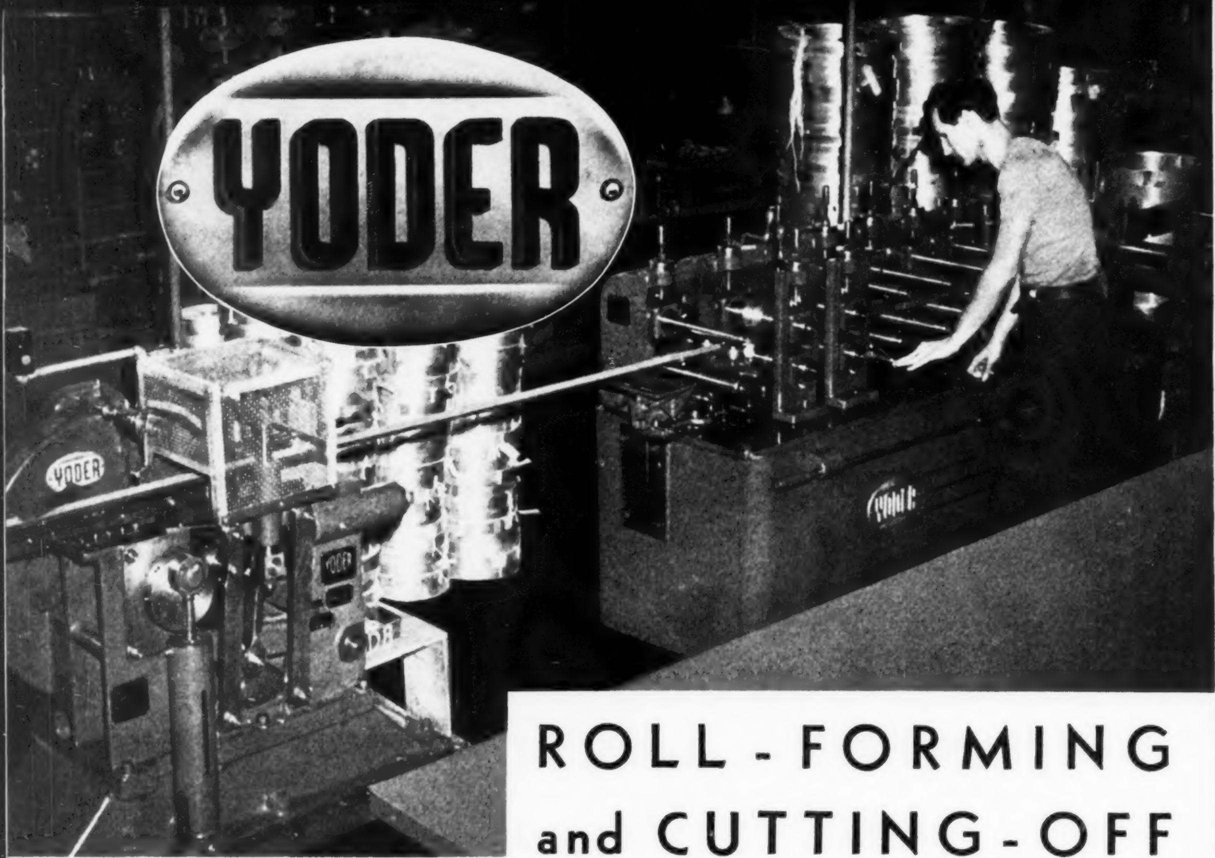


...speeds up Defense Production

This line-up of Niagara Power Squaring Shears in one of America's largest airplane plants is typical of many similar installations throughout industry. Accurate, flat cutting and more working strokes per hour are two factors responsible for the large number in service. Their well developed design also results in reliability and freedom from down time. Bulletins give complete data on wide range of sizes and capacities. Niagara Machine & Tool Works, Buffalo, N. Y. Branches: Leader Building, Cleveland; General Motors Bldg., Detroit; 50 Church St., New York.

NIAGARA

PRESSES • • • SHEARS • • • MACHINES FOR PLATE AND SHEET METAL WORK



ROLL-FORMING and CUTTING-OFF DURAL AIRCRAFT STOCK

The Consolidated Aircraft Corporation of San Diego, California, builders of giant patrol bombers and flying boats, uses this battery of a Yoder Roll Forming Machine and a Yoder Cutting-Off Machine to produce formed sections of dural aircraft stock. Working in synchronization, the two machines form the stock and cut it off to length in one continuous, high speed operation. In the first machine, rolls may be quickly changed to form any of the many shapes required in aircraft manufacture. In the following operation, a simple adjustment allows any length to be cut . . . .

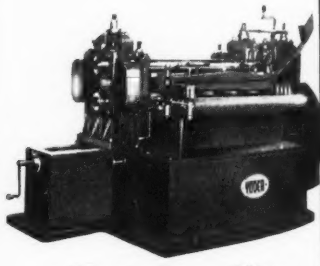
Write for further details and list of Yoder Products.

THE YODER COMPANY

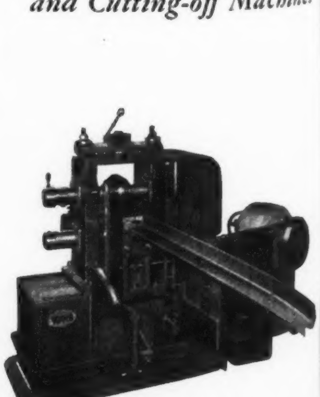
5500 WALWORTH AVENUE
CLEVELAND, OHIO

The YODER LINE *also includes:*

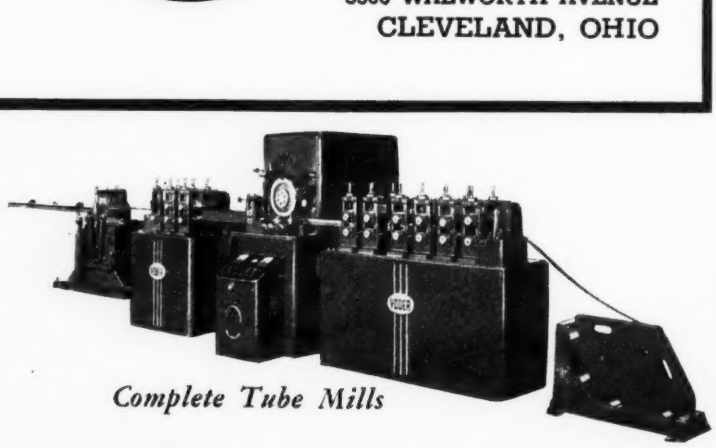

Cut-off Equipment


Sheet Gang Slitters and Side Trimmers


Ring Forming, Coiling and Cutting-off Machines


Cam type Bending Machines


Roll Forming Machinery


Complete Tube Mills

CLEVELAND PRESSES

INSIDE VENTILATOR

Twin Coach

ROOF PANEL · TANK HEAD · WINDOW PANEL

In the field of transportation

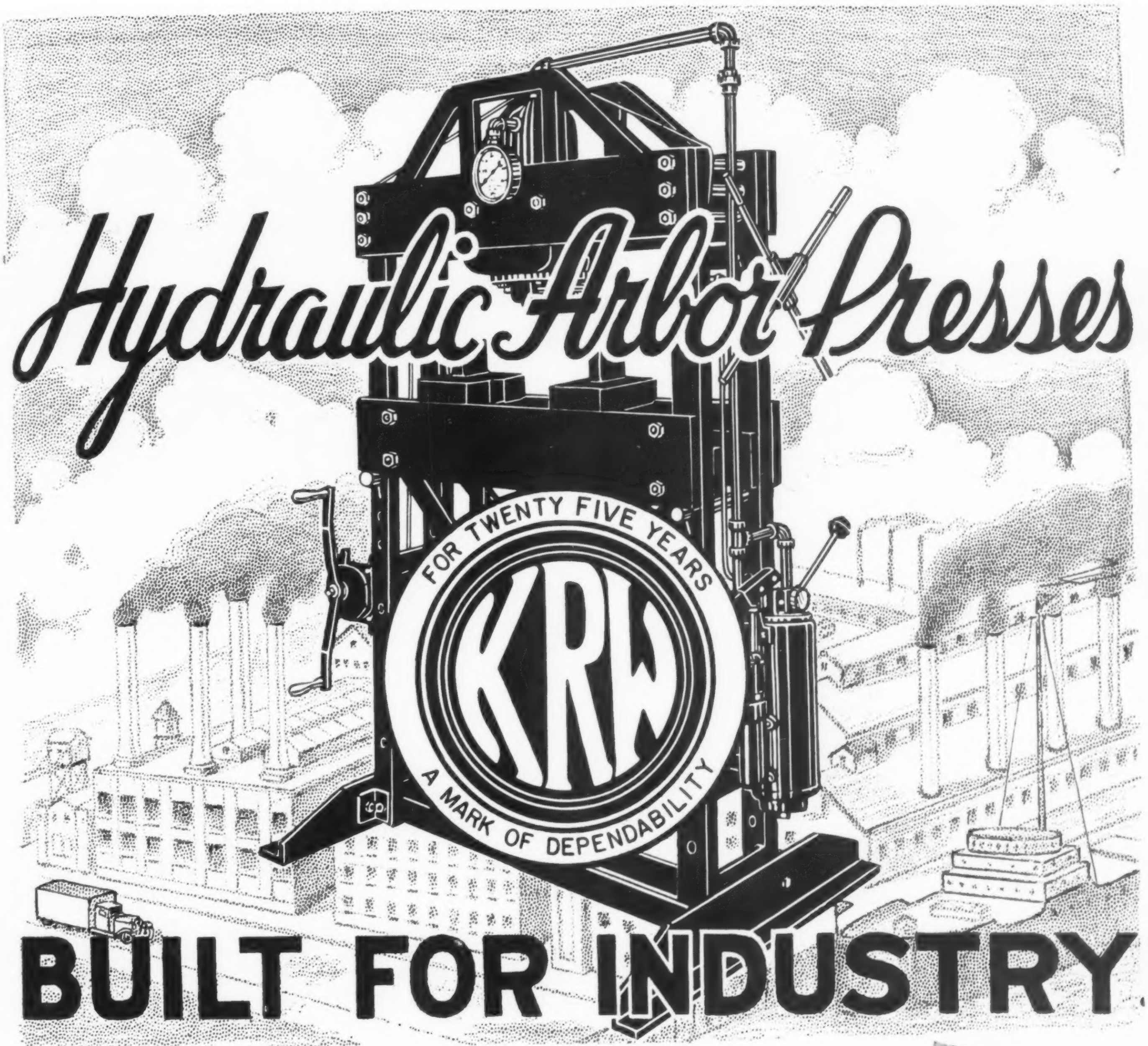
Unlike modern production methods commonly associated with the manufacture of Automobiles, Coaches do not "flow" in a steady stream from fast moving assembly lines.

Therefore, in selecting Modern Cleveland Two Point Presses for the production of the numerous pressed metal parts used in the construction of the Twin Coaches, the management of this well known Company was particularly impressed with the versatility of this type of Press and its adaptability to their varied needs, and while the Press can be operated continuously at a comparatively high rate of speed, speed was not one of their essential requirements. Ease of operation and accessibility for the quick change from one set of dies to another, were of greater import, and these features, together with the fact that Modern Cleveland Presses can be operated as efficiently and economically on small as well as on large dies, were the factors which influenced their selection of Cleveland Two Point Presses.

In the upper picture, the Press is shown equipped with dies for forming the inside ventilator while the lower picture shows a few of the many other parts used in the construction of Twin Coaches.

Modern Presses

THE CLEVELAND PUNCH & SHEAR WORKS CO., *Cleveland, Ohio*



KRW Hydraulic Arbor Presses meet industry's demand for SPEED. Speed in getting the ram to the work—Speed in developing required tonnage pressure—Speed in raising the ram to remove the work.

Send for your copy of the new 16-page bulletin describing in detail the NEW 2 Speed Pump—the Lever Controlled Valve that opens or closes with a flip of the Ball Arm—and many other patented features found only on KRW Presses.

Built in 25, 50 and 75 ton sizes. Prices start as low as $180.00. Compare before you buy.

K. R. WILSON

MAIN OFFICE: LOCK STREET, BUFFALO, N. Y., U. S. A.
EXPORT OFFICE: 90 WEST STREET, NEW YORK, N. Y., U. S. A.
WEST COAST: 722 MATEO ST., LOS ANGELES, CAL., U. S. A.

MAIL THIS COUPON

K. R. WILSON, 36 Lock St., Buffalo, N. Y.
Please send Hydraulic Arbor Press Bulletin No. 36.

Name....................................
Address....................................
City....................State............

Extra Large Capacity

TURRETS

FOR FABRICATING SHEETS AND PLATES

Type R-41-P deep-throated Wiedemann Turret Punch Press. Three standard throat depths — 18" — 24" — 28". Choice of 18 stations, 16 stations, 14 stations or 12 stations with hole diameters ranging from ⅛" to 3". See bulletin for full specifications.

•

Bulletins for these well-known and popular Turret Punch Presses should be on the desk of every manufacturing official who is interested in production and economy. Your bulletin will be sent without the least obligation or sales-pressure.

These **Turret Punch Presses** by **Wiedemann** are deep-throated, large capacity machines designed for rapid, continuous duty. No interference from adjacent punches and dies, because only one station can be in operation at one time. All die holders are plainly marked with diameters and maximum thickness of sheets for which they are intended. Alloy steel and chrome vanadium steel on vital parts. These presses are thoroughly dependable for speed and profitable high production.

WIEDEMANN MACHINE COMPANY
1801 Sedgley Ave., Philadelphia, Pa.

WIEDEMANN TURRET PUNCH PRESSES

OSTER

Makes
PIPE AND BOLT THREADERS
• • •
HAND SCREW MACHINES

A TOOL OR MACHINE FOR PRACTICALLY EVERY REQUIREMENT

WRITE FOR **NEW 1941** CATALOG OR TELL US YOUR PROBLEMS AND WE'LL GLADLY DISCUSS THEM WITH YOU

The OSTER MANUFACTURING CO.
2073 EAST 61st STREET
CLEVELAND, OHIO

BETTER-MADE DIE SETS — **BAUMBACH** — AT LOWER COST

46 DIFFERENT STYLES — OVER 195,000 SIZES

STANDARDIZED DIE SETS

Machined Steel — Semi-Steel

Drop Forged Steel
Send for Our New Catalog

E. A. BAUMBACH MFG. CO.
1810 South Kilbourn Ave. Chicago, Ill.

GRAY TURRET HEAD METAL CUTTER OR NIBBLER

GRAY, Originator of First Practical Metal Cutter or Nibbler

Most modern Nibbler for Template Cutting, Tool Rooms, Shipbuilding, Aircraft Parts, Aircraft Tubing, Sheet and Plate Shops.

GRAY MACHINE CO. Box 596, PHILADELPHIA, PA.

AUTOMATIC MACHINERY — BAIRD — BRIDGEPORT CONNECTICUT U.S.A.

MULTIPLE SPINDLE LATHES
MULTIPLE SPINDLE GRINDERS
WIRE FORMING MACHINES
FOOT AND POWER PRESSES
TUMBLING EQUIPMENT

THE BAIRD MACHINE COMPANY
BRIDGEPORT, CONN.

QUANTITY, YES—BUT QUALITY ALWAYS!

Our production facilities are set up for the primary purpose of producing stock gears in large quantities. To maintain the interchangeability of our stock gears it is absolutely essential that a constant check be kept on quality of workmanship and materials.

To accomplish this, our Inspection Department is equipped with precision testing machines, tooth comparators, hardness testers, special gauges, special fixtures and other essential equipment. One of our inspectors is shown above checking production gauges with a set of Johansson gauge blocks — accurate to millionths of an inch.

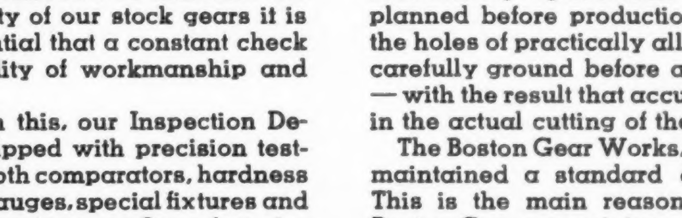
To obtain the best finished product actual machining operations are carefully planned before production. For example, the holes of practically all gear blanks are carefully ground before any teeth are cut — with the result that accuracy is obtained in the actual cutting of the gear.

The Boston Gear Works, Inc. has always maintained a standard of high quality. This is the main reason why so many Boston Gears are giving satisfactory service in all types of industry.

Quantity, Yes — but Quality Always!

BOSTON GEAR WORKS, INC., NORTH QUINCY, MASSACHUSETTS

THE complete line of Boston Gear Stock Products includes: gears, speed reducers, chain and sprockets, couplings, universal joints, pillow blocks, bearings, etc.



SEND for your free copy of our General Catalog #53 containing complete specifications and list prices on all our gears and other power transmission equipment.

PRESSURE PRODUCTION . . .

Demands of the defense program have necessitated the use of every available facility in our shops. However, every Diefendorf customer is being given the utmost co-operation in order that normal manufacturing processes can be maintained . . . We are equipped to make all types of gears, of any material, for machinery maintenance and production units.

DIEFENDORF GEAR CORP., Syracuse. N. Y.

DIEFENDORF GEARS

The selection of Cincinnati Gears for your production job definitely assures you of getting "FULL TIME" performance and acceptance for your work.

For 40 years industry has preferred the "Right Gear For The Job" as made by The Cincinnati Gear Co. Dependable, accurate and step by step tested, Cincinnati Gears should be demanded for your job.

From ¼" to 6' . . . from any materials . . . in any quantity . . . a special design or standard units, this is the story of Cincinnati Gears. We would like to work with you on your gear problems . . . for full time performance.

THE CINCINNATI GEAR COMPANY
"Gears . . . Good Gears Only"
1831 Reading Road • Cincinnati, Ohio

ALL TYPES OF GEARS
Any Material
Any Quantity
Any Size

OVER A QUARTER CENTURY MAKING GEARS

BRAUN GEAR COMPANY
1592-1608 ATLANTIC AVE.
BROOKLYN, N. Y.

GANSCHOW GEARS

FOR SIXTY YEARS

Spur—**SPEED REDUCERS**—Worm

ALL TYPES OF CUT GEARS

GANSCHOW GEAR CO., 1015 W. Washington, CHICAGO

CUT GEARS

All Types and Sizes

Baldwin Roller Chain and Sprockets

Heat Treated Alloy Steel Gears to Customer's Specifications

Special Gears and Special Gear Units

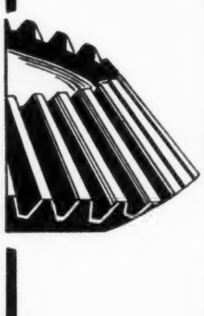
PITTSBURGH GEAR & MACHINE CO.

27th and Smallman Sts., Pittsburgh, Pa.

For Good Gears—QUICK!

ATLANTIC

Call Atlantic for quick service on any gear job . . . repair work, specially cut gears, or standard gears from our extensive stock of over 2000 types and sizes always ready for shipment.



Write for useful pocket catalog.

ATLANTIC GEAR WORKS, Inc.
202 Lafayette St., New York.

New Design — New Features — New Advantages

THE LATEST IN

GEAR HOBBING MACHINES

NEWARK GEAR CUTTING MACHINE CO.

69 Prospect Street, NEWARK, NEW JERSEY

GEARS—ALL MAKES . . . Special and Standard

PRECISION GEARS UP TO 200 DIAMETRAL PITCH

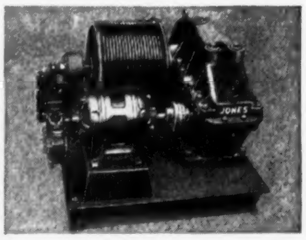
All Gears certified for Accuracy Quality and Fine Workmanship

NEW JERSEY GEAR & MFG. CO.
406 Stanton St. Newark, N. J.

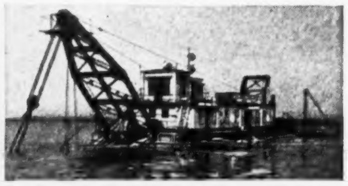
BUILT *for the* JOB!

HERE are three views of Jones Herringbone Reducer units that were built to meet special requirements and unusual service conditions. They are typical of many modifications that have been made of Jones Herringbone Worm and Spur Gear Reducer units for a wide variety of industrial applications.

Along with your requirements for standard drives the Jones organization offers a broad service on special drive units.

● A locomotive coaling station equipped with a Jones skip hoist unit. These skip hoists are built as complete units by the Jones organization.

● This hydraulic dredge has Jones Herringbone Reducers for driving the cutter head shaft and the drums.


● An oil field pumping unit driven by a special Jones double type Herringbone Reducer through V-Belts from a gas engine.

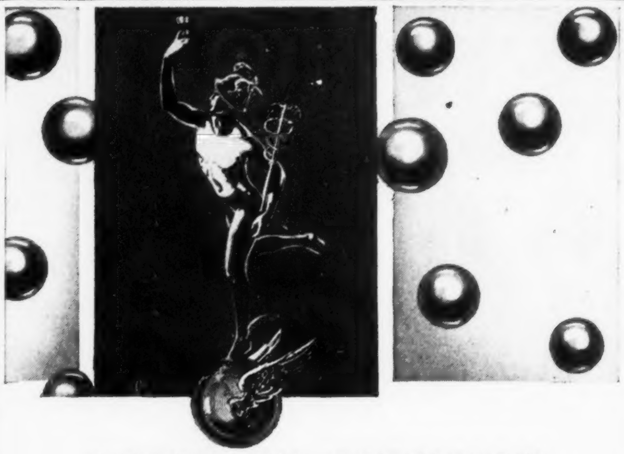
Both standard and special applications of Herringbone Reducers are covered in this Jones Catalog No. 70. Technical information shows how to select reducers for all conditions of service in accordance with the A.G.M.A. recommended practice.

We shall be pleased to send you a copy.

W. A. JONES FOUNDRY & MACHINE CO.
4409 Roosevelt Road, Chicago, Illinois

Jones

HERRINGBONE—WORM—SPUR — GEAR SPEED REDUCERS
CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES
ANTI — FRICTION PILLOW BLOCKS • PULLEYS
FRICTION CLUTCHES • TRANSMISSION APPLIANCES



ACCURACY—PRECISION

All WATERBURY STEEL BALLS are of uniform hardness which extends to the center of each ball. Made of high carbon chrome alloy steel highly finished.

WATERBURY STEEL BALLS

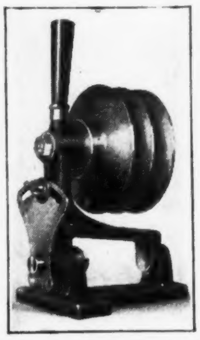
HIGH CARBON CHROME ALLOY STEEL, BRONZE, MONEL METAL, STAINLESS STEEL BALLS, STANDARD OR SPECIAL SIZES. WRITE FOR COMPLETE INFORMATION.

THE WATERBURY STEEL BALL CO., INC.
Poughkeepsie, New York
Factory: Waterbury, Conn.

TOLEDO VARIABLE SPEED TRANSMISSIONS

Low in Cost
Easy to Install
Convenient Size
Simple to Operate
No Belts to Shift
Infinite Speed Selection in Stepless Speed Changes

Write today for literature and quotations.



For Variable Speed Control of V-Belt Driven Equipment

Provide up to 10 to 1 Ratio with Power Ratings from Fractional to 4 H.P.

All Types Available Either in Complete Assembly or Wheel Assembly Only.

If you have a variable speed requirement it will pay you to investigate these devices.

THE TOLEDO TIMER CO. 2224 ALBION STREET TOLEDO, OHIO

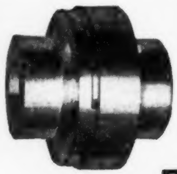
Heavy Duty Thrust Bearings

STANDARD SIZES or SPECIAL DESIGN to your specifications.
Send sketch or sample for quotation—without obligation.

Any Quantity—One Bearing or Many. Catalog Upon Request.
THE GWILLIAM CO., 360 Furman St., Brooklyn, N.Y.

L-R FLEXIBLE COUPLINGS

REAL PROTECTION

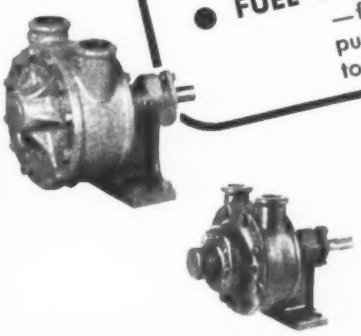


TYPE H

Use the L-R Type H wherever great strength, efficiency, and long life are required. Made of electric steel. New type has collar holding free-floating load cushions. Many sizes and types. Special couplings engineered to your requirements. Write for complete catalog.

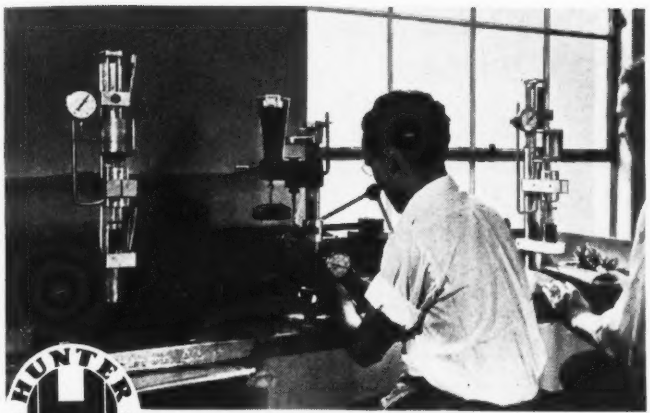
LOVEJOY FLEXIBLE COUPLING CO.
5021 WEST LAKE STREET CHICAGO, ILLINOIS


BOWER
ROLLER BEARING CO.
Detroit, Michigan
For NATIONAL SECURITY



Precision Testing at Production Speeds

SPECIALLY DESIGNED TESTING MACHINES
ASSURE UNIFORM HUNTER QUALITY



HUNTER SPRINGS - STAMPINGS

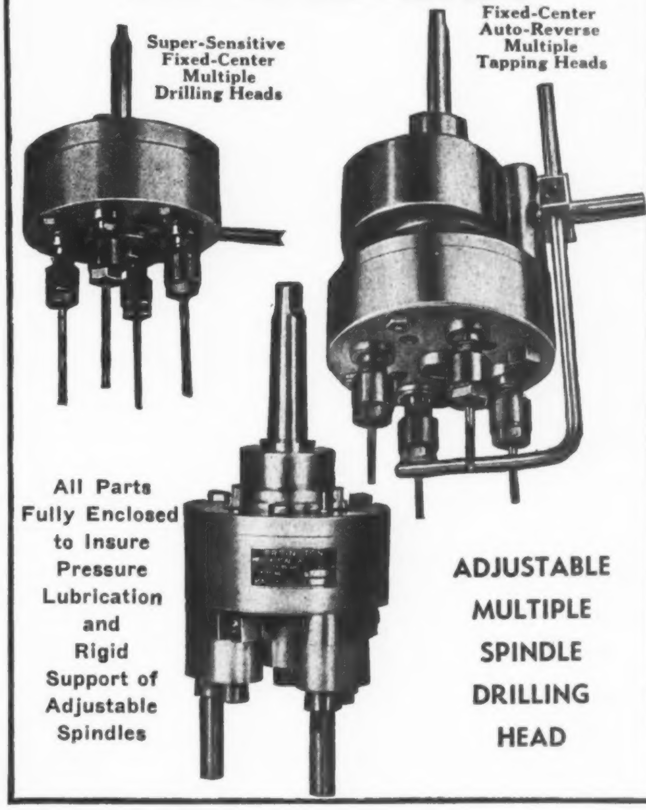
HUNTER SPRINGS ARE ENGINEERED SPRINGS!

Developed by our Research and Engineering organizations, new high speed machines solve the problem of 100% production load-testing of springs at *increased precision* standards and at *decreased cost.*

Such equipment *guarantees* that Hunter *quality*—originating through superior engineering ability and the best in production equipment operated by skilled and experienced spring makers—is maintained at all times.

HUNTER PRESSED STEEL CO • LANSDALE PENNSYLVANIA

ERRINGTON
STAPLETON, STATEN ISLAND, N. Y.
MULTIPLE HEADS



MADISON BORING BARS

LESS TIME OUT FOR TOOL REGRINDS

Because Madison Boring Bars have floating cutters that compensate for misalignment . . . because they never overheat or distort, cutting edges last longer. Use them for all holes from 5/8" up. They'll produce holes accurate to .00025" at less than cost to ream.

MADISON
Manufacturing Co.
Muskegon, Mich.

Face While Boring

M-D Facing Head can be attached to Column Boring Bar, and Drilling or Milling Machine spindles. Single point tool travels radially, from center outward or reverse, feeds automatically, and covers faces 6" to 30". Write for prices.

MUMMERT-DIXON COMPANY
HANOVER, PA.

Famous for

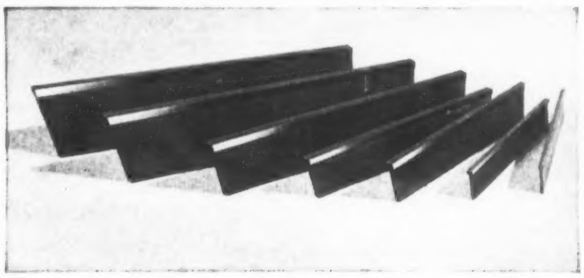
—ACCURACY OF THREADS—LOW CHASER COST—ALL AROUND DEPENDABILITY. Bulletins available: General Purpose Die Heads, Insert Chaser Die Heads, Threading Machines.

THE EASTERN MACHINE SCREW CORP.
23-43 BARCLAY ST., NEW HAVEN, CONN.

LOS ANGELES A. C. Behringer, 312 Commercial St., SAN FRANCISCO Guy Reynolds, 464 Vernon St., Oakland, CANADA: Arthur Jackson Mch. Tool Co., Toronto and Montreal.

See our Advt. on Page 426 July Machinery

LUERS CUTTING-OFF BLADES



SPEED PRODUCTION—CUT COSTS ON AVIATION DEFENSE JOB

This was a vital operation, running 24 hours a day on three shifts. Eight times a day the blades had to be sharpened—the machines stopped. One machine alone used *four* 8" blades every seven days.

Luers blades were tried. They had to be sharpened only *once* every 24 hours. And only *one inch* off of one blade was used every seven days.

Luers patented cutting-off blades and holders are saving time, money, and materials, in addition to turning out more work, because of the design that guarantees adequate side-clearance, back-clearance and free chip expansion.

WRITE FOR LITERATURE

Tell us the make and model of your automatic or hand screw machines. You'll get illustrated literature and full information by return mail, covering application to your own equipment.

Produced under license issued by John Milton Luers Patents Inc.

EMPIRE TOOL CO. 8790 GRINNELL AVE. DETROIT, MICHIGAN

CLASSIFIED AND RE-SALE

Rates for Advertisements—$6.50 Column Inch Each Insertion

EMCO REBUILT MACHINE TOOLS

RADIAL DRILLS

3′ Mueller, gear box
3′ American Sensitive, cone
3′ Carlton Sensitive
2½′ Avey Sensitive
4′ Hammond Sensitive
4′ Cincinnati Bickford, motor drive
4′ Niles-Bement-Pond Semi-Universal, M.D.
4′ Ryerson Plain, gear box
5′ American Triple Geared, gear box
5′ Bickford Plain, D.C. M.D.
5′ Dreses Plain, gear box
5′, 6′ Niles-Bement-Pond Semi-Universal, gr. box
5′, 6′ Niles-Bement-Pond Semi-Univ., D.C. M.D.
5′ Prentice Plain, cone
6′ Dresses Plain, gear box
7′ Dreses Plain, gear box
7′ Fosdick Plain, cone

GEAR CUTTERS AND HOBBERS

No. 61, 62, 645 Fellows Gear Shapers
6—18″ Gleason Straight Tooth Bevel Gear Generators
16″ Cincinnati Hobber, M.D.
No. 1 Lees-Bradner Gear Hobbers, M.D.
No. 3—26″ Brown & Sharpe Cutter
No. 3—26″ Cincinnati Gear Cutter
No. 3 Heavy Brown & Sharpe Gear Cutter
No. 5A Lees-Bradner Gear Generators
No. 6—60″ and 6—72″ Brown & Sharpe Gear Cutters
Gleason Spiral Bevel Gear Rougher, S.P.D.
Gleason Bevel Gear Tester, belt
Cross Gear Tooth Rounder, belt
Rochester Gear Tooth Rounder, belt
Schuchardt & Schutte Gear Tooth Rounder, belt
No. 1 Whiton Full Universal Spur and Bevel Gear Cutter, belt

AUTOMATICS

⅜-½″ Cleveland, Model B, belt
4 spindle ⅞″ Cleveland, Model M, M.D.
⅞″ Cleveland, Model A, belt
1¼-1½″ Cleveland, Model B, belt
2″ Cleveland, Model A, belt
No. 5A, 6A Potter & Johnston Automatics, M.D.
No. 6D Potter & Johnston Automatics, M.D.
No. 23, 24 New Britain 4 spindle, chucking

SHEET METAL MACHINERY

No. 2 Southwark Rotary Shear, M.D., 30″ throat, 8 ga.
No. 34 Lennox Rotary Bevel Shear, cap. ¾″, belt
Southwark Rotary Shear, cap. ⅜″, has 36″ throat
Quickwork Circle Shear, 30″ throat, 16 ga., belt
McCabe Pneumatic Flanger, ½″ cap.
7′ Robinson Hand Brake, 18 ga.
No. 22 Williams & White Eye Bender, M.D.
8′ Niles-Bement-Pond Hand Flanger, ¼″ cap.
10′ Niles-Bement-Pond Hand Flanger, ¼″ cap.
No. 1 Campbell Nibbler, belt, cap. 3/16″, has 6″ throat
No. 2 Campbell Nibbler, M.D., cap. ⅜″, has 12″ throat
No. 10A Quickwork Double Seamer, belt
Magee Sheet Metal Wiring and Edging Machine, M.D.

TAPPING MACHINES

No. 1 Garvin Knee Type, belt
No. 2 Garvin Automatic, belt
No. 2 Garvin Automatic, M.D.
No. 2X Garvin Automatic, M.D.
No. 2X Garvin Automatic, belt
Gaterman Oscillating Pneumatic, belt
½″ Rickert & Shaffer Vertical, belt
No. 5 Webster & Perks 5 spindle Nut Tapper, belt
6 spindle 1″ Acme Semi-Automatic Nut Tapper, belt

WELDERS

200 ampere Lincoln, M.D.
300 ampere Hobart, gasoline engine driven
12″ Winfield Spot, 20 KVA, cap. 1/16″
Winfield Spot, 100 amperes, 47 KVA, 18″ throat
Thompson-Gibb Spot, 40 KVA, 21″ throat
Federal Spot, 25 KW, 30″ throat
300 ampere Lincoln, M.D.
300 ampere General Electric, M.D.

MISCELLANEOUS

No. 5 Williams & White Bulldozer, belt
Norton Running Balance Indicating Machine, M.D.
Sprague Electric Dynamometer Laboratory Test, 250 HP, 1500 RPM, 570 ampere, 250 volt, with control equipment
No. 2 Cochran-Bly Filing Machine, belt
No. 1 Fischer Oil Groover
Production Polishing Machine, belt
No. 11 Cochran-Bly Saw Sharpener, M.D.
⅜″ and ¼″ Shuster Wire Straighteners

PARTIAL LISTING ONLY. SEND US YOUR INQUIRIES.

THE EASTERN MACHINERY CO.
1006 TENNESSEE AVENUE, CINCINNATI, OHIO

PLANERS FOR EARLY DELIVERY

We have the following new Liberty Double Housing Planers for delivery early this fall:

42″ x 42″ x 12′	Sept. 1941
48″ x 48″ x 14′	Nov. 1941
48″ x 48″ x 16′	Sept. 1941
48″ x 48″ x 18′	Dec. 1941
72″ x 72″ x 20′	Nov. 1941

These planers are subject to prior sale.

We also have the following used, rebuilt planers:

36″ x 36″ x 10′ Liberty Double Housing
55″ x 55″ x 30′ Betts Double Housing
100″ x 48″ x 38′ Liberty Convertible Open Side Planer

LIBERTY PLANERS, Hamilton, Ohio

CIMSCO Rebuilt Machine Tools

LATHES

14″x6′ Vernon Q.C., cone drive
15″x8′ Cisco Q.C., cone drive
18″x12′ Hamilton Q.C., cone drive
21″x10′ LeBlond, cone
24″x10′ Bradford, cone drive
24″x12′ Boye & Emmes Q.C., cone drive
18″x8′ Monarch 3 S.C.D., D.B.G.
36″x16′ Boye & Emmes Q.C., cone drive
50″x14′ Pittsburgh, cone drive, trip. grd.
16″x8′ American, grd. hd. S.P.D.

RADIALS AND UPRIGHT DRILLS

2½′, 3′, 3½′, 6′ Cintl. Bick. S.P.D.
3, 4, 5 and 6′ American Triple Purpose, S.P.D.
3 Mueller Plain, S.P.D.
24″ Cincinnati Bickford Plain, Tapping

GEAR CUTTERS AND HOBBERS

Nos. 1 and 3 Adams Farwell Gear Hobbers
6″ Gleason Bevel Gear Generators
No. 2 and No. 3 Adams Farwell Hobbers
No. 3—36″; No. 4—36″ B&S

BORING MILLS

60″ Gisholt Vertical Boring Mill, M.D.
3¼″ Bar Niles Horizontal
84″ Pond, 2 heads

SHAPERS AND PLANERS

16″, 20″ and 24″ Gould & Eberhardt, high duty
24″ Kelley Shaper
30″x30″x10′ Cincinnati, 1 head

MILLING MACHINES

No. 3B Brown & Sharpe Plain, S.P.D.
No. 6 Whitney Hand Miller
No. 1½ Cincinnati Universal, cone drive

GRINDERS

3′ Pratt & Whitney Surf. Grinder
6x18, 12x36, 16x48 Landis S/C

MISCELLANEOUS

3″ Landis Bolt Cutter
2″ Landis Single spindle, cone drive
2½″ Landis Bolt Cutter, Lead Screw
1½″ Cincinnati Automatic

If machines you need are not listed above, send us your inquiry. We have a very large stock.

Cincinnati Machinery & Supply Co.
217 E. Second St., Cincinnati, Ohio

WANTED

A new and rapidly expanding gage manufacturing company, backed by a well known aircraft parts manufacturer, located in the midwest, has excellent opportunities for:

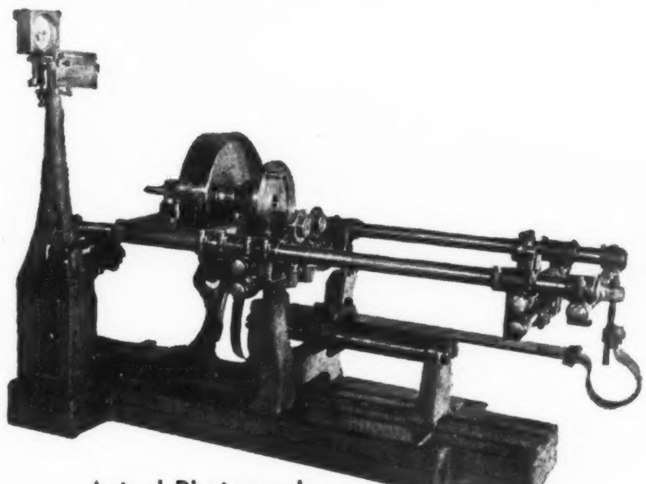
PLUG GAGE LEADER—
An experienced man capable of developing and running this division.

THREAD GAGE LEADER—
A man experienced in all methods of plug and ring manufacture to head this division.

CARBOLOY GAGES—
An experienced man to take complete charge of this department.

This is a real ground floor opportunity to join a progressive, modern equipped organization. We are seeking experienced men interested in bettering their present positions. State age, experience, education and salary expected. Box No. 468, MACHINERY, 148 Lafayette St., New York, N. Y.

Available for Immediate Delivery



Actual Photograph

Cost, New . . . $4150
Our Price $975

GISHOLT PRECISION BALANCING MACHINES

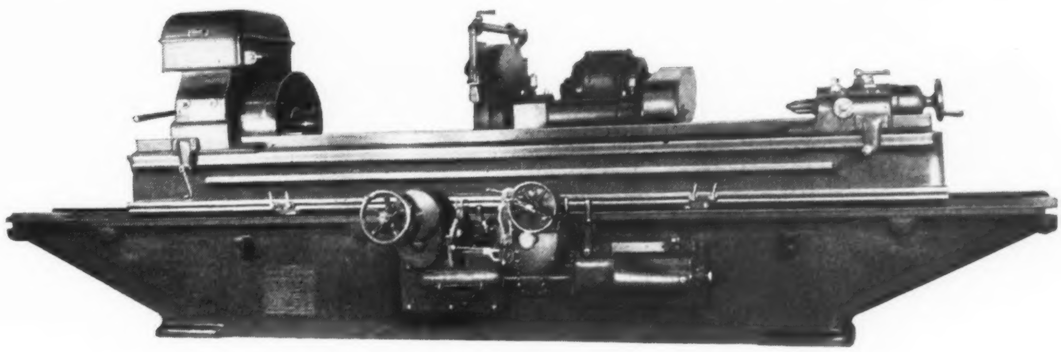
Used for the Detection of Unbalance in

ARMATURES · FLYWHEELS
CLUTCHES · PUMP IMPELLERS
CRANKSHAFTS

LOUIS E. EMERMAN & CO.

1761 Elston Ave. **Chicago, Ill.**

HILL-CLARKE MOTOR DRIVEN GRINDERS



SIZES IN STOCK:

6 x 32	10-15 GAP x 24	14 x 36	16 x 50	18 x 96	21 x 96
10 x 18	10 x 36	14 x 50	16 x 72	18-24 GAP x 96	
10 x 24	10 x 50	14 x 72	16 x 120		
	10 x 72				

COVERED BY U. S. PATENT NUMBERS
2074308 2112126
2095089 2139397

HILL-CLARKE MACHINERY CO.

648 WASHINGTON BLVD. **CHICAGO, ILL.**

REBUILT AND GUARANTEED MACHINES

Boring Mills

44" Baush Heavy Duty, M.D.
42" NBP Standard, M.D.
42" Colburn Heavy Duty, M.D.
3" Fitchburg Knee Type Horizontal
4¾" Niles Knee Type Horizontal

Planers

72" Morton Portable
42"x42"x16' Pond Motor Drive
42"x42"x13'6" Pond Rev. Motor (3)
42"x42"x12' Cincinnati Rev., M.D. (2)
30"x30"x12' Whitcomb Heavy Duty

Gear Cutters

60" Gould & Eberhardt
72" Gould & Eberhardt
Fellows Gear Shapers, No. 6, No. 62
No. 12 Barber-Colman Gear Hobbers

Millers

No. 2 Van Norman Duplex
No. 2 Cinc. Vertical M.D.
No. 3 Cinc. Vertical M.D.
No. C and No. C-2 Becker Vertical
No. 6—62" Becker Vertical
28" Cinc. Semi-Auto. Plain
24" Cinc. Duplex

Engine Lathes

36"x27' Pond Two Carriages
36"x27' Gleason
20"x14' Cisco Geared Head
20"x14' Walcott Geared Head
20"x14' L. & Sh. High Speed Prod.
18"x6' Davis Belt or Motor Drive

SPECIAL:

2 — 9" Spindle Ingersoll Horizontal Facing and Slotting Millers. Each machine can be used separately or jointly on a common base or floor plate for Facing or Slotting both ends of the work simultaneously. Available for immediate inspection.

Note: We solicit rebuilding and modernization of your own machines.

Tolerances and accuracy of our Rebuilt Machines unconditionally guaranteed

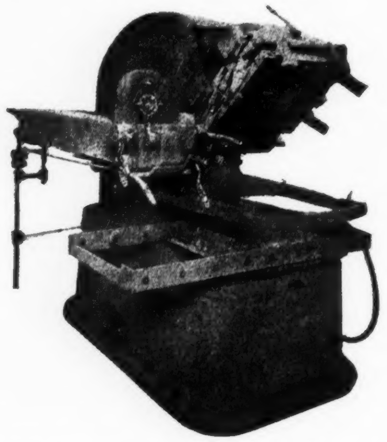
ATLANTIC MACHINERY CORPORATION

149 BROADWAY, NEW YORK — Tel. WOrth 2-0662 — Cable ATMACOR N. Y.

BUSCH SULZER

150-Ton DUO PRESS

These machines are to be disposed of at a fraction of their original cost. They were purchased from the former Grigsby-Grunow Co. and are in practically new condition.



If so desired, these presses may be shipped on a TRIAL BASIS

LOUIS E. EMERMAN & CO.

1761 ELSTON AVENUE — CHICAGO, ILLINOIS

TURRET LATHES

2¼x26" Cincinnati Acme, Bar and Chuck
10" 2-spdl. Jones & Lamson, Steel Head
3¼x36" Jones & Lamson
No. 1B Foster

SHAPERS—PLANERS

24" Stockbridge
30" Morton Draw Cut Shaper

BORING MILLS

51" Bullard Vertical
2—72" Bickford Verticals
1—4" bar. Beaman & Smith Floor Type Horiz.

MISCELLANEOUS

No. 6—72" Brown & Sharpe Gear Cutter
No. B—16 Natco, Multiple, 34 spindles
No. 1 Baker Keyseater
4-spindle Leland Gifford Drill
500 lb. Bradley Hammer
8" Standard Pipe Machine, M.D.
No. 4 Hilles & Jones Double Punch Shear
22"x46"x12' Putnam sliding head gap lathe
2" Pratt & Whitney Spline Miller
No. 21 S.A. Cochrane Bly Hi Speed Saw
No. 178 Toledo Toggle Press

WIGGLESWORTH MACHINERY COMPANY
198 Bent St., Cambridge, Mass.

QUALITY TOOLS

AUTOMATICS. 1¼" Cleveland 4 spindle
BROACH. No. 3 Oilgear hydraulic
DRILL, RADIAL. 4' and 5' Western
GEAR HOBBERS. Nos. 12 HS and 18 H Gould & Eberhardt
GRINDER. No. 2 Heim centerless
GRINDER. 10"x24", 10"x52", 12"x36" Landis
GRINDER. No. 75 Heald internal
LATHE. 36"x22' Schumacher Boye
LATHE, TURRET. 24" Bullard vertical
MILL, BORING. 60" Colburn
PLANER. 36"x36"x16' Cleveland openside
PLANER. 56"x56"x16' Gray, 4 heads
PRESS. 1300 ton Cleveland straight side
SHAPER. 36" and 48" Morton draw cut

MILES MACHINERY CO.
SAGINAW, MICH.

BLISS No. 4 TOGGLE DRAWING PRESS
Tie Rod Construction
1000 Machines in Stock—Investigate
MOREY MACHINERY CO., Inc
410 BROOME ST., NEW YORK

FOR SALE

GEAR CUTTERS, 30"x16" & 40"x12" G. & E.
GEAR CUTTER, Spur 84" Newark, M.D.
GEAR PLANERS, Bevel 54" Gleason, M.D.
HORIZ. MILLS, 2½", 3⅜" and 5" bar
GRINDER, Univ. No. 5 B&S, 20"x72"
LATHE, Geared Head, 24"x12' American
LATHE, Geared Head, 27"x11' LeBlond

LANG MACHINERY COMPANY
28th St. & A. V. R. R. — Pittsburgh, Pa.

POSITION OFFERED

Mechanical Engineer, experienced in the actual designing of machines and dies. Must understand the working of hot and cold metals. Please state training, experience, and all personal qualifications in your response. Position is in our Research and Developing Department and is a permanent one that offers splendid opportunity with growing Company, located in the Central States. Box 469, MACHINERY, 148 Lafayette St., New York, N. Y.

PRODUCT INDEX

For location of advertisements of manufacturers listed, see alphabetical index, pages 283-284

Hyatt Bearings Div., General Motors Sales Corp., Harrison, N. J.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Roller Bearing Co. of America, Trenton, N. J.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago.
S K F Industries, Inc., Philadelphia.
Standard Pressed Steel Co., Jenkintown, Pa.

BEARINGS, NEEDLE

Bantam Bearings Corp., South Bend, Ind.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Roller Bearing Co. of America, Trenton, N. J.
Torrington Co., Torrington, Conn.

BEARINGS, ROLLER

Ball & Roller Bearing Co., Danbury, Conn.
Bantam Bearings Corp., South Bend, Ind.
Bower Roller Bearing Co., Detroit.
Fafnir Bearing Co., New Britain, Ct.
Gwilliam Co., 360 Furman St., Brooklyn, N. Y.
Hyatt Bearings Div., General Motors Sales Corp., Harrison, N. J.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
McGill Manufacturing Co., Valparaiso, Ind.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Roller Bearing Co. of America, Trenton, N. J.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago.
S K F Industries, Inc., Philadelphia.
Timken Roller Bearing Co., Canton, O.

BEARINGS, SELF-LUBRICATING (OILLESS)

Arguto Oilless Bearing Co., Wayne Jct., Philadelphia.
Bunting Brass & Bronze Co., Toledo, O.
Johnson Bronze Co., New Castle, Pa.

BEARINGS, TAPERED ROLLER

Bantam Bearings Corp., South Bend, Ind.
Bower Roller Bearing Co., Detroit.
Timken Roller Bearing Co., Canton, O.

BEARINGS, THRUST

Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Ball & Roller Bearing Co., Danbury, Conn.
Bantam Bearings Corp., South Bend, Ind.
Bearings Co. of America, Lancaster, Pa.
Boston Gear Works, Inc., No. Quincy, Mass.
Bower Roller Bearing Co., Detroit.
Bunting Brass & Bronze Co., Toledo, O.
Fafnir Bearing Co., New Britain, Ct.
General Electric Co., Schenectady, N. Y.
Gwilliam Co., 360 Furman St., Brooklyn, N. Y.
Hill Acme Co., Cleveland, O.
Marlin-Rockwell Corp., Jamestown, N. Y.
McGill Manufacturing Co., Valparaiso, Ind.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago.
S K F Industries, Inc., Philadelphia.
Timken Roller Bearing Co., Canton, O.

BELT SHIFTERS

LeBlond, R. K., Mch. Tool Co., Cincinnati.
Ready Tool Co., Bridgeport, Conn.
Standard Pressed Steel Co., Jenkintown, Pa.

BENCHES, WORK, AND BENCH LEGS

Baumbach, E. A., Mfg. Co., 1810 S. Kilbourn Ave., Chicago.
Hill Acme Co., Cleveland, O.
Standard Pressed Steel Co., Jenkintown, Pa.

BENDING MACHINES, ANGLE IRON

Consolidated Mch. Tool Corp., Rochester, N. Y.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.

BENDING MACHINES, HYDRAULIC

Bethlehem Steel Co., Bethlehem, Pa.
Farquhar, A. B., Co., Ltd., York, Pa.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Morgan Engineering Co., Alliance, O.
Watson-Stillman Co., Roselle, N. J.

BENDING MACHINES, PIPE

Farquhar, A. B., Co., Ltd., York, Pa.
Watson-Stillman Co., Roselle, N. J.

BLAST CLEANING EQUIPMENT

Pangborn Corp., Hagerstown, Md.
Production Machine Co., Greenfield, Mass.
Walls Sales Corp., 96 Warren St., New York.

BLOCKS, CHAIN—See Hoists, etc.

BLOWERS

Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Ingersoll-Rand Co., 11 Broadway, New York.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

BLUEPRINT MACHINERY AND ACCESSORIES

Paragon-Revolute Corp., Rochester, N. Y.

BOILER TUBES

Bethlehem Steel Co., Bethlehem, Pa.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.

BOLT AND NUT MACHINERY

Denison Engineering Co., Columbus, O.
Landis Mch. Co., Inc., Waynesboro, Pa.
Modern Tool Works, Rochester, N. Y.
New Britain-Gridley Machine Div. New Britain Machine Co., New Britain, Conn.
Oster Manufacturing, Cleveland, O.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

BOLTS AND NUTS

Bethlehem Steel Co., Bethlehem, Pa.
National Acme Co., Cleveland.

BOOKS, TECHNICAL

Industrial Press, 148 Lafayette St., New York.

BORING AND DRILLING MACHINES, VERTICAL

Barnes Drill Co., Rockford, Ill.
Barnes, W. F., & John, Co., Rockford, Ill.
Bullard Company, Bridgeport, Conn.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Foote-Burt Co., Cleveland.
Gorton Machine Co., Racine, Wis.
Jones Machine Tool Works, Inc., Philadelphia, Pa.
Moline Tool Co., Moline, Ill.
National Acme Co., Cleveland.
Root, B. M., Co., York, Pa.
Sellers, Wm., & Co., Inc., Philadelphia.

BORING AND TURNING MILLS, VERTICAL

Bullard Company, Bridgeport, Conn.
Cincinnati Planer Co., Cincinnati.
Jones Machine Tool Works, Inc., Philadelphia, Pa.
Sellers, Wm., & Co., Inc., Philadelphia.

BORING BARS

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Bullard Company, Bridgeport, Conn.
Carboloy Co., Inc., Detroit.
Davis Boring Tool Div., St. Louis, Mo.
Ex-Cell-O Corp., Detroit.
Gairing Tool Co., Detroit.
Gisholt Machine Co., Madison, Wis.
Madison Mfg. Co., Muskegon Mich.
McCrosky Tool Corp., Meadville, Pa.
Ready Tool Co., Bridgeport, Conn.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Warner & Swasey Co., Cleveland.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

BORING, DRILLING AND MILLING MACHINES, HORIZONTAL

Barnes, W. F., & John, Co., Rockford, Ill.
Espen-Lucas Machine Works, Philadelphia.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Jones Machine Tool Works, Inc., Philadelphia, Pa.
Lucas Mch. Tool Co., Cleveland.
Moline Tool Co., Moline, Ill.
Ohio Machine Tool Co., Kenton, O.
Sellers, Wm., & Co., Inc., Philadelphia.
Universal Boring Machine Co., Hudson, Mass.

BORING HEADS
Davis Boring Tool Div., St. Louis, Mo.
Ex-Cell-O Corp., Detroit.
Gairing Tool Co., Detroit.
McCrosky Tool Corp., Meadville, Pa.

BORING HEADS, OFFSET
Gairing Tool Co., Detroit.
Rickert-Shafer Co., Erie, Pa.

BORING MACHINES, DIAMOND AND CARBIDE TOOL
Ex-Cell-O Corporation, Detroit.
Heald Machine Co., Worcester, Mass.
Stokerunit Corp., Milwaukee, Wis.

BORING MACHINES, JIG
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Cleereman Mch. Tool Co., Green Bay, Wis.
Machinery Mfg. Co., Los Angeles, Calif.
Reed-Prentice Corp., Worcester, Mass.
Pratt & Whitney Co., West Hartford, Conn.

BORING TOOLS
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago.
Carboloy Co., Inc., Detroit.
Davis Boring Tool Div., St. Louis, Mo.
Ex-Cell-O Corp., Detroit.
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit.
Gisholt Mch. Co., Madison, Wis.
Haynes Stellite Co., Kokomo, Ind.
Jones & Lamson Mch. Co., Springfield, Vt.
McCrosky Tool Corp., Meadville, Pa.
McKenna Metals Co., Latrobe, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Ready Tool Co., Bridgeport, Conn.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Union Twist Drill Co., Athol Mass.
Vascoloy-Ramet Corp., No. Chicago, Ill.
Warner & Swasey Co., Cleveland.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

BRAKES, PRESS AND BENDING
Cincinnati Shaper Co., Cincinnati.
Ferracute Machine Co., Bridgeton, N. J.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Steelweld Mchry. Div. of Cleveland Crane & Engrg. Co., Cleveland.
Watson-Stillman Co., Roselle, N. J.

BROACHES
American Broach & Mch. Co., Ann Arbor, Mich.
Carboloy Co., Inc., Detroit.
Ex-Cell-O Corporation, Detroit.
Firth-Sterling Steel Co., McKeesport, Pa.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
Lapointe Machine Tool Co., Hudson, Mass.
National Broach & Mch. Co., Detroit, Mich.

BROACHING MACHINES
American Broach & Mch. Co., Ann Arbor, Mich.
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Foote-Burt Co., Cleveland.
Lapointe Machine Tool Co., Hudson, Mass.
National Broach & Mch. Co., Detroit, Mich.

BRONZE
Bunting Brass & Bronze Co., Toledo, O.
Cramp Brass & Iron Foundries Co., Philadelphia, Pa.
Johnson Bronze Co., New Castle, Pa.

BUFFERS
Black & Decker Mfg. Co., Towson, Md. (Portable Electric).
Delta Mfg. Co., Milwaukee, Wis.
Gardner Mfg. Co., Beloit, Wis.
Production Machine Co., Greenfield, Mass.
Rotor Tool Co., Cleveland, O.
Stow Mfg. Co., Binghamton, N. Y. (Flexible Shaft).
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tools, Towson, Md. (Portable Electric).

BUFFERS (FLEXIBLE SHAFT)
Stow Mfg. Co., Binghamton, N. Y.

BULLDOZERS
Baldwin-Southwark Corp., Philadelphia, Pa.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Watson-Stillman Co., Roselle, N. J.

BURNISHING MACHINERY
Baird Machine Co., Bridgeport, Conn.

BUSHINGS, BRASS, BRONZE, ETC.
Boston Gear Works, Inc., No. Quincy, Mass.
Bunting Brass & Bronze Co., Toledo, O.
Haynes Stellite Co., Kokomo, Ind.
Johnson Bronze Co., New Castle, Pa.

BUSHINGS, HARDENED
Baumbach, E. A., Mfg. Co., 1810 S. Kilbourn Ave., Chicago.
Danly Machine Specialties, Inc., 2112 S. 52nd Ave., Chicago.
Leland-Gifford Co., Worcester, Mass.
U. S. Tool Company, Inc., Ampere, N. J.

BUSHINGS, JIG
Ex-Cell-O Corporation, Detroit.
Universal Engineering Co., Frankenmuth, Mich.

CABINETS, TOOL
Armstrong Brothers Tool Co., 313 No. Francisco Ave., Chicago.

CALIPERS
Brown & Sharpe Mfg. Co., Providence.
Starrett, L. S., Co., Athol, Mass.

CAM CUTTING MACHINES
Frew Machine Co., Philadelphia.
Pratt & Whitney Co., West Hartford, Conn.

CAM MILLING AND GRINDING MACHINES
Rowbottom Machine Co., Waterbury, Conn.

CAMS
Brown & Sharpe Mfg. Co., Providence (Screw Machines).
Hartford Special Mchry. Co., Hartford, Conn.
Kux-Lohner Machine Co., 2145 Lexington St., Chicago.
Rowbottom Machine Co., Waterbury, Conn.

CARBIDE, TANTALUM, TITANIUM AND TUNGSTEN
Carboloy Co., Inc., Detroit.
Firth-Sterling Steel Co., McKeesport, Pa.
McKenna Metals Co., Latrobe, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.
Vascoloy-Ramet Corp., No. Chicago, Ill.

CASE-HARDENING
Pittsburgh Gear & Machine Co., Pittsburgh, Pa.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

CASE-HARDENING FURNACES
See Furnaces, Heat Treating.

CASTINGS, BRASS, BRONZE AND ALUMINUM
Bethlehem Steel Co., Bethlehem, Pa. (Brass & Bronze only).
Bunting Brass & Bronze Co., Toledo, O.
Cramp Brass & Iron Foundries Co., Philadelphia, Pa.

CASTINGS, DIE
Madison-Kipp Corporation, Madison, Wis.
Veeder-Root, Inc., Hartford, Conn.

CASTINGS, GRAY IRON
Bethlehem Steel Co., Bethlehem, Pa.
Brown & Sharpe Mfg. Co., Providence.
Covel Mfg. Co., Benton Harbor, Mich.

CASTINGS, STEEL, ALLOY, ETC.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Cramp Brass & Iron Foundries Co., Philadelphia, Pa.
National-Erie Corp., 1521 Raspberry St., Erie, Pa.

CEMENT, DISC GRINDING WHEEL
Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Carborundum Co., Niagara Falls, N. Y.
Gardner Machine Co., Beloit, Wis.
Walls Sales Corp., 96 Warren St., New York.

CENTERING MACHINES
Consolidated Mch. Tool Corp., Rochester, N. Y.
Hanson-Whitney Machine Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., West Hartford, Conn.
Sundstrand Mch. Tool Co., Rockford, Ill.

CENTERS, LATHE
Carboloy Co., Inc., Detroit.
Firth-Sterling Steel Co., McKeesport, Pa.
McKenna Metals Co., Latrobe, Pa.
Modern Machine Corp., Brooklyn, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Ready Tool Co., Bridgeport, Conn.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Vascoloy-Ramet Corp., No. Chicago, Ill.

CENTERS, PLANER AND MILLER
Cincinnati Planer Co., Cincinnati.

CHAIN BLOCKS
See Hoists, Chain, etc.

CHAIN DRIVES
Morse Chain Co., Ithaca, N. Y.
Whitney Chain & Mfg. Co., Hartford, Conn.

CHAINS, POWER TRANSMISSION AND CONVEYOR
Boston Gear Works, Inc., No. Quincy, Mass.
Philadelphia Gear Works, Philadelphia.
Whitney Chain & Mfg. Co., Hartford, Conn.

CHAMFERING MACHINES, GEAR TOOTH
Bilgram Gear & Mch. Works, Philadelphia.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Cross Gear & Machine Co., Detroit, Mich.
Grant Mfg. & Mch. Co., Bridgeport, Conn.
Lipe, W. C., Inc., Syracuse, N. Y.
Schatz Mfg. Co., Poughkeepsie, N. Y.

CHISELS AND CHISEL BLANKS, PNEUMATIC HAMMER
American Swiss File & Tool Co., Elizabeth, N. J.
Bethlehem Steel Co., Bethlehem, Pa.

CHUCKING MACHINES
Bardons & Oliver, Inc., Cleveland, O.
Baird Machine Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence.
Bullard Company, Bridgeport, Conn.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Machine Co., Madison, Wis.
Goss & De Leeuw Mch. Co., New Britain, Conn.
International Machine Tool Corp. (Foster Div.), Elkhart, Ind.
Jones & Lamson Machine Co., Springfield, Vt.
National Acme Co., Cleveland.
New Britain-Gridley Machine Div., New Britain Machine Co., New Britain, Conn.
Potter & Johnston Mch. Co., Pawtucket, R. I.
Sundstrand Mch. Tool Co., Rockford, Ill.
Warner & Swasey Co., Cleveland.

CHUCKING MACHINES, MULTIPLE SPINDLE
Goss & De Leeuw Mch. Co., New Britain, Conn.
National Acme Co., Cleveland.
New Britain-Gridley Machine Div., New Britain Machine Co., New Britain, Conn.

CHUCKS, AIR-OPERATED
Airgrip Chuck Div., Anker-Holth Mfg. Co., Port Huron, Mich.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.

CHUCKS, COLLET OR SPLIT
See Collets.

CHUCKS, DIAPHRAGM
Van Norman Mch. Tool Co., Springfield, Mass.

CHUCKS, DRILL
Cleveland Twist Drill Co., Cleveland.
Itco Tool Co., Brooklyn, N. Y.
Jacobs Mfg. Co., Hartford, Conn.
McCrosky Tool Corp., Meadville, Pa.
Modern Tool Works, Rochester, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Procunier Safety Chuck Co., 18 S. Clinton St., Chicago.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.

CHUCKS, FULL FLOATING
Errington Mechanical Laboratory, 200 Broadway, New York.
Gisholt Mch. Co., Madison, Wis.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.

CHUCKS, LATHE, ETC.
Bullard Company, Bridgeport, Conn.
Cushman Chuck Co., Hartford, Conn.
Gisholt Mch. Co., Madison, Wis.
International Machine Tool Corp. (Foster Div.), Elkhart, Ind.
Jones & Lamson Mch. Co., Springfield, Vt.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Warner & Swasey Co., Cleveland.

CHUCKS, MAGNETIC
Arter Grinding Machine Co., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Walker, O. S., Co., Inc., Worcester, Mass.

CHUCKS, QUICK CHANGE AND SAFETY
Errington Mechanical Laboratory, 200 Broadway, New York.
McCrosky Tool Corp., Meadville, Pa.
Modern Tool Wks., Rochester, N. Y.
Procunier Safety Chuck Co., 18 S. Clinton St., Chicago.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.

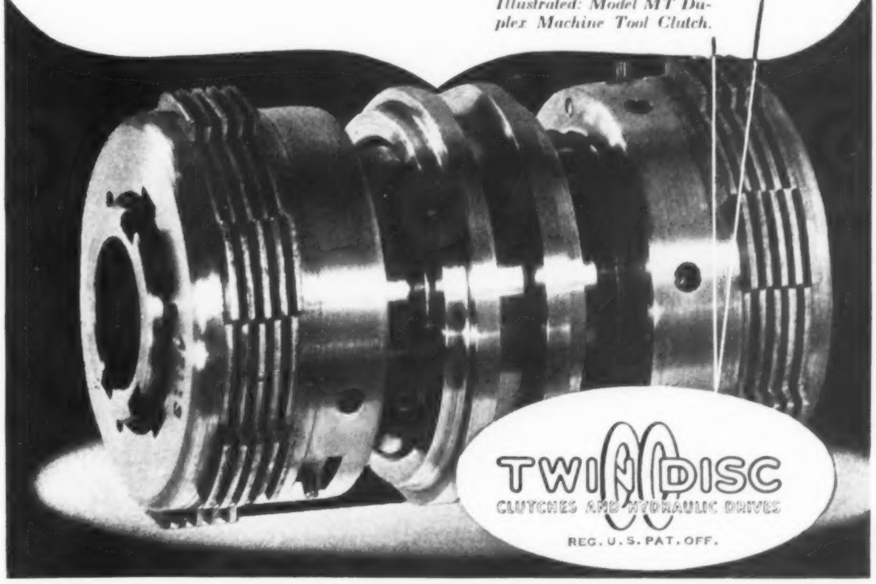
CHUCKS, RING WHEEL
Gardner Machine Co., Beloit, Wis.

CHUCKS, TAPPING
Barber-Colman Co., Rockford, Ill.
Errington Mechanical Laboratory, 200 Broadway, New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jacobs Mfg. Co., Hartford, Conn.
McCrosky Tool Corp., Meadville, Pa.
Procunier Safety Chuck Co., 18 S. Clinton St., Chicago.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.

CLAMPS
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago.
Baumbach, E. A., Mfg. Co., 1810 S. Kilbourn Ave., Chicago.
Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Brown & Sharpe Mfg. Co., Providence.
Danly Mch. Specialties, Inc., 2112 So. 52nd Ave., Chicago.
Starrett, L. S., Co., Athol, Mass.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

CLEANERS, CHEMICAL, FOR METAL
Bullard Co., Bullard-Dunn Process Div., Bridgeport, Conn.
Oakite Products Inc., 26 Thames St., New York.

CLUTCHES
Barnes Drill Co., Rockford, Ill.
Clearing Mch. Corp., 6499 W. 65th St., Chicago.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.



Hill Acme Co., Cleveland, O.
Hilliard Corp., Elmira, N. Y.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Lipe, W. C., Inc., Syracuse, N. Y.
Morse Chain Co., Ithaca, N. Y.
Rockford Drilling Mch. Div., Rockford, Ill.
Twin Disc Clutch Co., Racine, Wis.

COATINGS, PROTECTIVE

Bullard Co., Bullard-Dunn Process Div., Bridgeport, Conn.
Bakelite Corp., 30 East 42nd St., New York.

COLLARS, SAFETY

Hill Acme Co., Cleveland, O.
Standard Pressed Steel Co., Jenkintown, Pa.

COLLARS, SPACING, ETC.

Scully-Jones & Co., 1903 S. Rockwell St., Chicago.

COLLETS

Ames, B. C., Co., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence.
Cleveland Twist Drill Co., Cleveland.
Gisholt Mch. Co., Madison, Wis.
Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago.
Hardinge Brothers, Inc., Elmira, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Wks., Rochester, N. Y.
New Britain-Gridley Machine Div., New Britain Machine Co., New Britain, Conn.
Pratt & Whitney Co., West Hartford, Conn.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Union Twist Drill Co., Athol, Mass.
Universal Engineering Co., Frankenmuth, Mich.
Warner & Swasey Co., Cleveland.

COMPARATORS, SCREW THREAD

Jones & Lamson Mch. Co., Springfield, Vt.

COMPOUNDS, CLEANING

Oakite Products, Inc., 26 Thames St., New York.

COMPOUNDS, CUTTING, GRINDING, METAL DRAWING, ETC.

Gulf Oil Corp., Pittsburgh, Pa.
National Broach & Mch. Co., Detroit, Mich. (Broaching and Lapping).
Oakite Products, Inc., 26 Thames St., New York.
Shell Oil Co., Inc., New York, St. Louis, San Francisco.
Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago.
Stuart, D. A., Oil Co., Ltd., 2727 So. Troy St., Chicago, Ill.
Sun Oil Co., Philadelphia.
Texas Co., 135 East 42nd St., New York.
Tide Water Associated Oil Co., 17 Battery Place, New York.

COMPOUNDS, LAPPING

Clover Mfg. Co., Norwalk, Conn.

COMPOUNDS, RESIN OR MOLDING

Bakelite Corp., 30 East 42nd St., New York.
General Electric Co., Schenectady, N. Y.

COMPRESSORS, AIR

Ingersoll-Rand Co., 11 Broadway, New York.

CONTRACT WORK

Columbus Die, Tool & Mch. Co., Columbus, O.
Diefendorf Gear Corp., Syracuse, N. Y.
Ex-Cell-O Corp., Detroit.
Hartford Special Mchry. Co., Hartford, Conn.
Hill Acme Co., Cleveland, O.
Langelier Mfg. Co., Providence.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Lees-Bradner Co., Cleveland.
Modern Mch. Corp., 323 Berry St., Brooklyn, N. Y.
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., Cleveland.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Taylor-Shantz, Inc., Rochester, N. Y.
U. S. Tool Company, Inc., Ampere, N. J.

CONTROLLERS

Allen-Bradley Co., Milwaukee, Wis.
Clark Controller Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

CONVEYOR ROLLS, ROLLER BEARING

Shafer Bearing Corp., 35 E. Wacker Drive, Chicago.

COUNTERBORES

Carboloy Co., Inc., Detroit.
Cleveland Twist Drill Co., Cleveland.
Ex-Cell-O Corporation, Detroit.
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit.
Haynes Stellite Co., Kokomo, Ind.
McKenna Metals Co., Latrobe, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., West Hartford, Conn.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Starrett, L. S., Co., Athol, Mass.
Union Twist Drill Co., Athol, Mass.

COUNTERSHAFTS

Hill Acme Co., Cleveland, O.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Standard Pressed Steel Co., Jenkintown, Pa.
Warner & Swasey Co., Cleveland.

COUNTERSINKS

Ex-Cell-O Corporation, Detroit.
Gairing Tool Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Union Twist Drill Co., Athol, Mass.

COUNTERS, REVOLUTION

Brown & Sharpe Mfg. Co., Providence.
Starrett, L. S., Co., Athol, Mass.
Veeder-Root, Inc., Hartford, Conn.

COUNTING DEVICES

Starrett, L. S., Co., Athol, Mass.
Veeder-Root, Inc., Hartford, Conn.

COUPLINGS, FLEXIBLE

Atlantic Gear Works, Inc., 200 Lafayette St., New York.
Baldor Electric Co., St. Louis, Mo.
Boston Gear Works, Inc., No. Quincy, Mass.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Hill Acme Co., Cleveland, O.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Lovejoy Flexible Coupling Co., 5021 W. Lake St., Chicago.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia.
Whitney Chain & Mfg. Co., Hartford, Conn.

COUPLINGS, SHAFT

Boston Gear Works, Inc., No. Quincy, Mass.
Hill Acme Co., Cleveland, O.
Hilliard Corp., Elmira, N. Y.
Sellers, Wm., & Co., Inc., Philadelphia.
Standard Pressed Steel Co., Jenkintown, Pa.

CRANES, ELECTRIC TRAVELING

Morgan Engineering Co., Alliance, O.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

CRANES, HAND TRAVELING

Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

CRANES, LOCOMOTIVE

Cullen-Friestedt Co., 1305 S. Kilbourn Ave., Chicago.

CRANES, PORTABLE

Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Hill Acme Co., Cleveland, O.

DIE STOCKS
See Stocks, Die.

DIES, SHEET METAL, ETC.
Baumbach, E. A., Mfg. Co., 1810 S. Kilbourn Ave., Chicago.
Columbus Die, Tool & Mch. Co., Columbus, O.
Ferracute Machine Co., Bridgeton, N. J.
Modern Machine Corp., Brooklyn, N. Y.
Niagara Mch. & Tool Wks., Buffalo, N. Y.
Pioneer Engineering & Mfg. Co., Detroit, Mich.
Ruthman Mchry. Co., Cincinnati.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
V & O Press Co., Hudson, N. Y.
Waltham Mch. Wks., Waltham, Mass.

DIES, THREADING
Brown & Sharpe Mfg. Co., Providence.
Butterfield Div. Union Twist Drill Co., Derby Line, Vt.
Card, S. W., Mfg. Co., Mansfield, Mass.
Eastern Mch. Screw Corp., New Haven, Conn.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Inc., Waynesboro, Pa.
Modern Tool Works, Rochester, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Murchey Mch. & Tool Co., Detroit.
National Acme Co., Cleveland.
Oster Manufacturing, Cleveland, O.
Pratt & Whitney Co., West Hartford, Conn.
Winter Bros. Co., Wrentham, Mass.

DIES, THREADING, OPENING
Brown & Sharpe Mfg. Co., Providence.
Eastern Mch. Screw Corp., New Haven, Conn.
Errington Mechanical Lab., 200 Broadway, New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Inc., Waynesboro, Pa.
Modern Tool Wks., Rochester, N. Y.
Murchey Mch. & Tool Co., Detroit.
National Acme Co., Cleveland.
Oster Manufacturing Cleveland, O.
Rickert-Shafer Co., Erie, Pa.

DIES, THREAD ROLLING
Hanson-Whitney Mch. Co., Hartford, Conn.
Pratt & Whitney Co., West Hartford, Conn.

DISCS, ABRASIVE
Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Carborundum Co., Niagara Falls, N. Y.
Gardner Mch. Co., Beloit, Wis.
Hanchett Mfg. Co., Big Rapids, Mich.
Norton Co., Worcester, Mass.
Walls Sales Corp., 96 Warren St., New York.

DIVIDING HEADS
See Index Centers.

DOWEL PINS
Allen Mfg. Co., Hartford, Conn.
Baumbach, E. A., Mfg. Co., 1810 S. Kilbourn Ave., Chicago.
Danly Mch. Specialties, Inc., 2112 S. 52nd Ave., Chicago.
U. S. Tool Company, Inc., Ampere, N J.

DRESSERS, GRINDING WHEEL
American Swiss File & Tool Co., Elizabeth, N. J.
Carboloy Co., Inc., Detroit.
Desmond-Stephan Mfg. Co., Urbana, O.
Norton Co., Worcester, Mass.

DRIFTS, DRILL
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.

DRILL HEADS, MULTIPLE
Barnes Drill Co., Rockford, Ill.
Delta Mfg. Co., Milwaukee, Wis.
Ettco Tool Co., Brooklyn, N. Y.
Errington Mechanical Lab., 200 Broadway, New York.
Ex-Cell-O Corp., Detroit.
Langelier Mfg. Co., Providence.
Moline Tool Co., Moline, Ill.
Root, B. M., Co., York, Pa.

DRILL SOCKETS
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Writney Co., West Hartford, Conn.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Union Twist Drill Co., Athol, Mass.

DRILL SPEEDERS
Graham Mfg. Co., Inc., E. Greenwich, R. I.

DRILL STANDS
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford. Mass.
National Twist Drill & Tool Co., Detroit.
Union Twist Dril Co., Athol, Mass.
United States Electrical Tool Co., Cincinnati.

DRILLING MACHINES, AUTOMATIC
Avey Drilling Mch. Co., Cincinnati, O.
Barnes Drill Co., Rockford, Ill.
Barnes, W. F., & John, Co., Rockford, Ill.
Bradford Machine Tool Co., Cincinnati, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Grant Mfg. & Mch. Co., Bridgeport, Conn.
Kingsbury Mch. Tool Corp., Keene, N. H.
Langelier Mfg. Co., Providence.
Root, B. M., Co., York, Pa.

DRILLING MACHINES, BENCH
Ames, B. C., Co., Waltham, Mass.
Atlas Press Co., Kalamazoo, Mich.
Avey Drilling Mch. Co., Cincinnati, O.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Delta Mfg. Co., Milwaukee, Wis.
Dumore Co., Racine, Wis.
Elgin Tool Wks., Inc., Berteau & Ravenswood Ave., Chicago.
Henry & Wright Mfg. Co., Hartford, Ct.
Langelier Mfg. Co., Providence.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
Production Machine Co., Greenfield, Mass.
Ryerson, Joseph T., & Son. Inc., 2558 W. 16th St., Chicago.
United States Electrical Tool Co., Cincinnati.

DRILLING MACHINES, BOILER
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Foote-Burt Co., Cleveland.
Sellers, Wm., & Co., Inc., Philadelphia.

DRILLING MACHINES, GANG
Avey Drilling Mch. Co., Cincinnati, O.
Barnes Drill Co., Rockford, Ill.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Cleereman Mch. Tool Co., Green Bay, Wis.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Delta Mfg. Co., Milwaukee, Wis.
Foote-Burt Co., Cleveland.
Langelier Mfg. Co., Providence.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
Production Machine Co., Greenfield, Mass.
Root, B. M., Co., York, Pa.
Sellers, Wm., & Co., Inc., Philadelphia.

DRILLING MACHINES, HORIZONTAL DUPLEX
Avey Drilling Mch. Co., Cincinnati, O.
Barnes, W. F., & John, Co., Rockford, Ill.
Bradford Machine Tool Co., Cincinnati, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., Milwaukee, Wis.
Frew Machine Co., Philadelphia.
Kingsbury Mch. Tool Corp., Keene, N. H.
Langelier Mfg. Co., Providence.
Moline Tool Co., Moline, Ill.
Murchey Mch. & Tool Co., Detroit.
Sundstrand Mch. Tool Co., Rockford, Ill.

DRILLING MACHINES, MULTIPLE SPINDLE
Avey Drilling Mch. Co., Cincinnati, O.
Barnes Drill Co., Rockford. Ill.
Barnes, W. F., & John, Co., Rockford, Ill.
Baush Machine Tool Co., Springfield, Mass.
Bradford Machine Tool Co., Cincinnati, O.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Cleereman Mch. Tool Co., Green Bay, Wis.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Delta Mfg. Co., Milwaukee, Wis.
Foote-Burt Co., Cleveland.
Greenlee Bros. & Co., Rockford, Ill.
Henry & Wright Mfg. Co., Hartford, Ct.
Kingsbury Mch. Tool Corp., Keene, N. H.
Langelier Mfg. Co., Providence.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
Pratt & Whitney Co., West Hartford, Conn.
Production Mch. Co., Greenfield, Mass.
Root, B. M., Co., York, Pa.
Sellers, Wm., & Co., Inc., Philadelphia.

DRILLING MACHINES, RADIAL
American Tool Wks., Co., Cincinnati.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Carlton Machine Tool Co., Cincinnati.
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Sellers. Wm., & Co., Inc., Philadelphia.

DRILLING MACHINES, RAIL
See Drilling Machines, Gang.

DRILLING MACHINES, SENSITIVE
Atlas Press Co., Kalamazoo, Mich.
Avey Drilling Mch. Co., Cincinnati, O.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Delta Mfg. Co., Milwaukee, Wis.
Foote-Burt Co., Cleveland.
Henry & Wright Mfg. Co., Hartford, Ct.
Langelier Mfg. Co., Providence.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
Pratt & Whitney Co., West Hartford, Conn.
Production Mch. Co., Greenfield, Mass.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

DRILLING MACHINES, UPRIGHT
Atlas Press Co., Kalamazoo, Mich.
Barnes Drill Co., Rockford, Ill.
Barnes, W. F., & John, Co., Rockford, Ill.
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Cleereman Mch. Tool Co., Green Bay, Wis.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Delta Mfg. Co., Milwaukee, Wis.
Foote-Burt Co., Cleveland.
Langelier Mfg. Co., Providence.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
Production Machine Co., Greenfield, Mass.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Sellers, Wm., & Co., Inc., Philadelphia.

DRILLING MACHINES, WALL RADIAL
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cleveland Punch & Shear Works Co., Cleveland, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.

DRILLS, CENTER
Cleveland Twist Drill Co., Cleveland.
Gairing Tool Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., West Hartford, Conn.
Union Twist Drill Co., Athol, Mass.
Warner & Swasey Co., Cleveland.

DRILLS, CORE
Carboloy Co., Inc., Detroit.
Ex-Cell-O Corp., Detroit.
Gairing Tool Co., Detroit.
Haynes Stellite Co., Kokomo, Ind.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Union Twist Drill Co., Athol, Mass.
Vascoloy-Ramet Corp., No. Chicago. Ill.

DRILLS, PORTABLE ELECTRIC
Black & Decker Mfg. Co., Towson, Md.
Dumore Co., Racine, Wis.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tools, Towson, Md.

DRILLS, PORTABLE PNEUMATIC
Ingersoll-Rand Co., 11 Broadway, New York.
Rotor Tool Co., Cleveland, O.

DRILLS, RATCHET
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., West Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

DRILLS, TWIST
Carboloy Co., Inc., Detroit.
Cleveland Twist Drill Co., Cleveland.
Firth-Sterling Steel Co., McKeesport, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., West Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

DRILLS, WIRE
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Union Twist Drill Co., Athol, Mass.

DRIVES, MOTORIZED BELT
Cullman Wheel Co., 1339 Altgeld St., Chicago.

DUST CONTROL SYSTEMS
American Air Filter Co., Inc., Louisville, Ky.
Covel Mfg. Co., Benton Harbor, Mich.
Pangborn Corp., Hagerstown, Md.

ELECTRICAL EQUIPMENT
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

EMERY WHEELS
See Grinding Wheels.

EMERY WHEEL DRESSERS
See Dressers, Grinding Wheel

ENGRAVING MACHINES
Gorton Machine Co., Racine. Wis.
United States Electrical Tool Co., Cincinnati.

EXTRACTORS, SCREW
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

FACING MACHINE
Ex-Cell-O Corp., Detroit.

FANS, EXHAUST, ELECTRIC VENTILATING
General Electric Co., Schenectady, N. Y.
Wagner Electric Co., St. Louis, Mo.

FEEDS FOR PUNCH PRESSES, AUTOMATIC
Cleveland Punch & Shear Works Co., Cleveland, O.
S. & S. Machine Wks., 4541 W. Lake St., Chicago.
U. S. Tool Company, Inc., Ampere, N. J.
V & O Press Co., Hudson, N. Y.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

FILES
American Swiss File & Tool Co., Elizabeth, N. J.
Nicholson File Co., Providence.

FILES, MACHINE
Oliver Instrument Co., Adrian, Mich.

FILES, ROTARY
Pratt & Whitney Co., West Hartford, Conn.
Stow Mfg. Co., Binghamton, N. Y.
Strand, N. A., & Co., 5001 N. Wolcott Ave., Chicago.

FILTERS, AIR
American Air Filter Co., Inc., Louisville, Ky.
United States Electrical Tool Co., Cincinnati.

FILING MACHINES, DIE, ETC.
Ames, B. C., Co., Waltham, Mass.
Continental Machines, Inc., Minneapolis, Minn.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
Oliver Instrument Co., Adrian, Mich.
Stow Mfg. Co., Binghamton, N. Y.

FITTINGS, HYDRAULIC
Watson-Stillman Co., Roselle, N. J.

FLEXIBLE COUPLINGS
See Couplings, Flexible.

FLEXIBLE SHAFT EQUIPMENT
Dumore Co., Racine, Wis.
Haskins, R. G., Co., 617 So. California Ave., Chicago.
Pratt & Whitney Co., West Hartford, Conn.
Stow Mfg. Co., Binghamton, N. Y.
Strand, N. A., & Co., 5001 N. Wolcott Ave., Chicago.
United States Electrical Tool Co., Cincinnati.

FORGING (UPSETTING) MACHINES
Baldwin-Southwark Corp., Philadelphia, Pa.
Waterbury Farrel Fdry. & Mch. Co. (Cold), Waterbury, Conn.

FORGINGS, DROP
Bethlehem Steel Co., Bethlehem, Pa.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

FORGINGS, HOLLOW BORED
American Hollow Boring Co., Erie, Pa.
Bethlehem Steel Co., Bethlehem, Pa.

FORGINGS, IRON AND STEEL
Bethlehem Steel Co., Bethlehem, Pa.
Morgan Engineering Co., Alliance, O.

FORGINGS, MANGANESE, BRONZE, ETC.
Cramp Brass & Iron Foundries Co., Philadelphia, Pa.

FORGINGS, UPSET
Bethlehem Steel Co., Bethlehem, Pa.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

FORMING AND BENDING MACHINES
Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Cincinnati Shaper Co., Cincinnati.
Cleveland Punch & Shear Works Co., Cleveland, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Ferracute Machine Co., Bridgeton, N. J.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Yoder Co., Cleveland, O.

FORMING AND STAMPING MACHINES
Cincinnati Shaper Co., Cincinnati.
U. S. Tool Company, Inc., Ampere, N. J.

FORMING TOOLS OR TOOL BLANKS
Brown & Sharpe Mfg. Co., Providence.
National Broach & Mch. Co., Detroit, Mich.
Pratt & Whitney Co., West Hartford, Conn.

FRAMES, MACHINERY, WELDED
Mahon, R. C., Co., Detroit, Mich.

FURNACES, HARDNESS
Leeds & Northrup Co., Philadelphia.

FURNACES, HEAT-TREATING ELECTRIC
General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., Philadelphia.

FURNITURE, SHOP
Standard Pressed Steel Co., Jenkintown, Pa.

GAGE BLOCKS
Johansson Div., Ford Motor Co., Dearborn, Mich.
Pratt & Whitney Co., West Hartford, Conn.

GAGES, COMPARATOR
Comtor Co., Waltham, Mass.
Federal Products Corp., Providence, R. I.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., West Hartford, Conn.

GAGES, DEPTH
Brown & Sharpe Mfg. Co., Providence.
Federal Products Corp., Providence, R. I.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Starrett, L. S., Co., Athol, Mass.

GAGES, DIAL
Ames, B. C., Co., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence.
Federal Products Corp., Providence, R. I.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Starrett, L. S., Co., Athol, Mass.

GAGES, ELECTRIC
Pratt & Whitney Co., West Hartford, Conn

GAGES, HEIGHT
Brown & Sharpe Mfg. Co., Providence.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Starrett, L. S., Co., Athol, Mass.

GAGES, PLUG, RING AND SNAP

Brown & Sharpe Mfg. Co., Providence.
Carboloy Co., Inc., Detroit.
Ex-Cell-O Corporation, Detroit.
Federal Products Corp., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Haynes Stellite Co., Kokomo, Ind.
Illinois Gage Co., 3753 N. Kilbourn Ave., Chicago, Ill.
McKenna Metals Co., Latrobe, Pa.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., West Hartford, Conn.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Starrett, L. S., Co., Athol, Mass.

GAGES, SURFACE

Brown & Sharpe Mfg. Co., Providence.
Columbus Die, Tool & Mch. Co., Columbus, O.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Starrett, L. S., Co., Athol, Mass.

GAGES, TAPER

Brown & Sharpe Mfg. Co., Providence.
Johansson Div., Ford Motor Co., Dearborn, Mich.
Pratt & Whitney Co., West Hartford, Conn.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Starrett, L. S., Co., Athol, Mass.

GAGES, THREAD

Brown & Sharpe Mfg. Co., Providence.
Federal Products Corp., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Machine Co., Hartford, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., West Hartford, Conn.
Starrett, L. S., Co., Athol, Mass.

GASKETS

Garlock Packing Co., Palmyra, N. Y.

GEAR BLANKS, NON-METALLIC

Braun Gear Co., Brooklyn, N. Y.
Ganschow Gear Co., 16 N. Morgan St., Chicago.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

GEAR BURNISHING MACHINES

Fellows Gear Shaper Co., Springfield, Vt.

GEAR CHECKING INSTRUMENTS AND EQUIPMENT

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
National Broach & Mch. Co., Detroit, Mich.
Pratt & Whitney Co., West Hartford, Conn.

GEARING CUTTING MACHINES, BEVEL (GENERATOR)

Bilgram Gear & Machine Wks., Philadelphia.
Gleason Works, Rochester, N. Y.

(ROTARY CUTTER)

Newark Gear Cutting Machine Co., Newark, N. Y.
Waltham Mch. Wks., Waltham, Mass.

GEAR CUTTING MACHINES, HELICAL & SPUR (HOB)

Barber-Colman Co., Rockford, Ill.
Lees-Bradner Co., Cleveland.
Newark Gear Cutting Machine Co., Newark, N. J.
New Jersey Gear & Mfg. Co., Newark, N. J.

(SHAPER OR PLANER TYPE)

Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Fellows Gear Shaper Co., Springfield, Vt.

GEAR CUTTING MACHINES, SPIRAL-BEVEL

Gleason Works, Rochester, N. Y.

GEAR CUTTING MACHINES, WORM AND WORM WHEELS

Barber-Colman Co., Rockford, Ill.
Fellows Gear Shaper Co., Springfield, Vt. (Straight & Hourglass Type).
Lees-Bradner Co., Cleveland.
New Jersey Gear & Mfg. Co., Newark, N. J.

GEAR FINISHING MACHINES

Fellows Gear Shaper Co., Springfield, Vt.

GEAR GRINDING MACHINES

Gleason Works, Rochester, N. Y.
Pratt & Whitney Co., West Hartford, Conn.

GEAR HARDENING MACHINES

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.

GEAR LAPPING MACHINES

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
National Broach & Mch. Co., Detroit.

GEAR MOTORS

See Speed Reducers.

GEAR SHAVING MACHINES

Fellows Gear Shaper Co., Springfield, Vt.
National Broach & Mch. Co., Detroit, Mich.

GEAR TESTING MACHINERY

Baldwin-Southwark Corp., Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Lees-Bradner Co., Cleveland.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Newark Gear Cutting Machine Co., Newark, N. J.
Pratt & Whitney Co., West Hartford, Conn.

GEAR TOOTH GRINDING MACHINES

Lees-Bradner Co., Cleveland.
Pratt & Whitney Co., West Hartford, Conn.

GEARS, CUT

Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Baush Machine Tool Co., Springfield, Mass.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Machine Works, Philadelphia.
Boston Gear Works, Inc., No. Quincy, Mass.
Braun Gear Co., Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence.
Cincinnati Gear Co., Cincinnati, O.
Cleveland Worm & Gear Co., Cleveland.
Crofoot, Chas. E., Gear Corp., So. Easton, Mass.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., Philadelphia.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow Gear Co., 16 N. Morgan St., Chicago.
General Electric Co., Pittsfield, Mass.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Inc., Boston, Mass.
Hartford Special Mchy. Co., Hartford, Conn.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Lees-Bradner Co., Cleveland.
Massachusetts Gear & Tool Co., Woburn, Mass.
Meisel Press Mfg. Co., Boston, Mass.
National-Erie Corp., 1521 Raspberry St., Erie, Pa.
Newark Gear Cutting Machine Co., Newark, N. J.
New Jersey Gear & Mfg. Co., Newark, N. J.
Ohio Gear Co., Cleveland, O.
Perkins Mch. & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia.
Pittsburgh Gear & Machine Co., Pittsburgh.
Stahl Gear & Machine Co., Cleveland.
Taylor Mch. Co., Cleveland.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

GEARS, MOLDED

Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
National-Erie Corp., 1521 Raspberry St., Erie, Pa.
Philadelphia Gear Wks., Philadelphia.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

GEARS, RAWHIDE AND NON-METALLIC

Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Boston Gear Works, Inc., No. Quincy, Mass.
Braun Gear Co., Brooklyn, N. Y.
Cincinnati Gear Co., Cincinnati, O.
Crofoot, Chas. E., Gear Corp., So. Easton, Mass.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., Philadelphia.
Ganschow Gear Co., 16 N. Morgan St., Chicago.
General Electric Co., Pittsfield, Mass.
Grant Gear Works, Inc., Boston, Mass.
Hartford Special Mchy. Co., Hartford, Conn.
Massachusetts Gear & Tool Co., Woburn, Mass.
Meisel Press Co., Boston, Mass.
Philadelphia Gear Works, Philadelphia.
Pittsburgh Gear & Machine Co., Pittsburgh.
Stahl Gear & Machine Co., Cleveland.
Taylor Mch. Co., Cleveland.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

GENERATORS, ELECTRIC

General Electric Co., Schenectady, N. Y.
Janette Mfg. Co., 556 W. Monroe St., Chicago.
Reliance Electric & Engrg. Co., Cleveland.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

GRADUATING MACHINES

Gorton Machine Co., Racine, Wis.

GREASE

Gulf Oil Corp., Pittsburgh, Pa.
Lubri-Zol Corp., Cleveland, O.
Shell Oil Co., Inc., New York, St. Louis, San Francisco.
Standard Oil Co. (Indiana), Chicago, Ill.
Sun Oil Co., Philadelphia.
Texas Co., 135 E. 42nd St., New York.
Tide Water Associated Oil Co., 17 Battery Place, New York.

GRINDERS, CARBIDE TOOL

Baldor Electric Co., St. Louis, Mo.
Oliver Instrument Co., Adrian, Mich.
Sundstrand Mch. Tool Co., Rockford, Ill.

GRINDERS, DIE AND MOLD

Consolidated Mch. Tool Corp., Rochester, N. Y.
Dumore Co., Racine, Wis.
Haskins, R. G., Co., 617 S. California Ave., Chicago.
Pratt & Whitney Co., West Hartford, Conn.
Stow Mfg. Co., Binghamton, N. Y.
United States Electrical Tool Co., Cincinnati.

GRINDERS, OILSTONE, FOR WOODWORKING TOOLS

Mummert-Dixon Co., Hanover, Pa.

GRINDERS, PNEUMATIC

Ingersoll-Rand Co., 11 Broadway, New York.
Madison-Kipp Corp., Madison, Wis.
Onsrud Machine Works, Inc., 3940 Palmer St., Chicago.
Rotor Tool Co., Cleveland, O.

GRINDERS, PORTABLE ELECTRIC AND TOOLPOST

Black & Decker Mfg. Co., Towson, Md.
Dumore Co., Racine, Wis.
Haskins, R. G., Co., 617 S. California Ave., Chicago.
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tools, Towson, Md.

GRINDING MACHINES, ABRASIVE BELT

Continental Machines, Inc., Minneapolis, Minn.
Delta Mfg. Co., Milwaukee, Wis.
Hill Acme Co., Cleveland, O.
Mattison Mch. Wks., Rockford, Ill.
Production Machine Co., Greenfield, Mass.
Walls Sales Corp., 96 Warren St., New York.

GRINDING MACHINES, BENCH

Atlas Press Co., Kalamazoo, Mich.
Black & Decker Mfg. Co., Towson, Md.
Delta Mfg. Co., Milwaukee, Wis.
Hardinge Brothers, Inc., Elmira, N. Y.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tools, Towson, Md.

GRINDING MACHINES, CAMSHAFT

Landis Tool Co., Waynesboro, Pa.
Norton Co., Worcester, Mass.

GRINDING MACHINES, CEMENTED CARBIDE TOOL

Carboloy Co., Inc., Detroit.
Ex-Cell-O Corporation, Detroit.
Oliver Instrument Co., Adrian, Mich.

GRINDING MACHINES, CENTERLESS

Cincinnati Grinders Inc., Cincinnati.

GRINDING MACHINES, CHASER, OR DIE

Eastern Mch. Screw Corp., New Haven, Conn.
Landis Mch. Co., Waynesboro, Pa.

GRINDING MACHINES, CHUCKING

Bryant Chucking Grinder Co., Springfield, Vt.

GRINDING MACHINES, CRANKSHAFT

Landis Tool Co., Waynesboro, Pa.
Norton Co., Worcester, Mass.

GRINDING MACHINES, CYLINDER

Bryant Chucking Grinder Co., Springfield, Vt.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.

GRINDING MACHINES, CYLINDRICAL

Arter Grinder Machine Co., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence.
Cincinnati Grinders Inc., Cincinnati.
Fitchburg Grinding Machine Corp., Fitchburg, Mass.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Wks. (Cons. Mch. Tool Corp.), Rochester, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Norton Co., Worcester, Mass.
Pratt & Whitney Co., West Hartford, Conn.

Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Thompson Grinder Co., Springfield, O.
United States Electrical Tool Co., Cincinnati.

GRINDING MACHINES, DISC

Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Gardner Machine Co., Beloit, Wis.
Hanchett Mfg. Co., Big Rapids, Mich.
Production Mch. Co., Greenfield, Mass.
United States Electrical Tool Co., Cincinnati.

GRINDING MACHINES, DRILL

Covel Mfg. Co., Benton Harbor, Mich.
Delta Mfg. Co., Milwaukee, Wis.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Oliver Instrument Co., Adrian, Mich.
Sellers, Wm., & Co., Inc., Philadelphia.
Union Twist Drill Co., Athol, Mass.

GRINDING MACHINES, FACE

Abrasive Mch. Tool Co., E., Providence, R. I.
Hanchett Mfg. Co., Big Rapids, Mich.
Oliver Instrument Co., Adrian, Mich.

GRINDING MACHINES, FLEXIBLE SHAFT

See Flexible Shaft Equipment.

GRINDING MACHINES FOR SHARPENING TURNING AND PLANING TOOLS

Delta Mfg. Co., Milwaukee, Wis.
General Machinery Corp., Boston, Mass.
Oliver Instrument Co., Adrian, Mich.
Production Mch. Co., Greenfield, Mass.
Sellers, Wm., & Co., Inc., Philadelphia, (Machine Ground).
Sundstrand Mch. Tool Co., Rockford, Ill.
Van Dorn Electric Tools, Towson, Md.
Walker, O. S., Co., Inc., Worcester, Mass.
Waltham Mch. Wks., Waltham, Mass.

GRINDING MACHINES, INTERNAL

Bryant Chucking Grinder Co., Springfield, Vt.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Wks. (Cons. Mch. Tool Corp.), Rochester, N. Y.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.

GRINDING MACHINES, KNIFE AND SHEAR BLADE

Hanchett Mfg. Co., Big Rapids, Mich.
Hill Acme Co., Cleveland, O.

GRINDING MACHINES, PISTON RING

Arter Grinding Machine Co., Worcester, Mass.
Heald Machine Co., Worcester, Mass.

GRINDING MACHINES, PULLEY

Abrasive Mch. Tool Co., East Providence, R. I.

GRINDING MACHINES, RADIAL, BALL RACE, ETC.

Landis Tool Co., Waynesboro, Pa.

GRINDING MACHINES, RADIUS, LINK

Consolidated Mch. Tool Corp., Rochester, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.

GRINDING MACHINES, RING WHEEL

Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Gardner Machine Co., Beloit, Wis.

GRINDING MACHINES, ROLL

Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Landis Tool Co., Waynesboro, Pa.
Norton Co., Worcester, Mass.

GRINDING MACHINES, SPLINE

Fitchburg Grinding Machine Corp., Fitchburg, Mass.

GRINDING MACHINES, SURFACE

Abrasive Mch. Tool Co., East Providence, R. I.
Arter Grinding Machine Co., Worcester, Mass.
Blanchard Mch. Co., Cambridge, Mass.
Brown & Sharpe Mfg. Co., Providence.
Continental Machines, Inc., Minneapolis, Minn.
Covel Mfg. Co., Benton Harbor, Mich.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Gardner Mch. Co., Beloit, Wis.
Hanchett Mfg. Co., Big Rapids, Mich.
Heald Machine Co., Worcester, Mass.
Hill Acme Co., Cleveland, O.
Mattison Machine Works, Rockford, Ill.
Norton Co., Worcester, Mass.
Pratt & Whitney Co., West Hartford, Conn.
Robot Machinery Co., 326 Ten Eyck St., Brooklyn, N. Y.
Thompson Grinder Co., Springfield, O.
United States Electrical Tool Co., Cincinnati.
Walker, O. S., Co., Inc., Worcester, Mass.

GRINDING MACHINES, SWING FRAME

United States Electrical Tool Co., Cincinnati.

GRINDING MACHINES, TAP

Ex-Cell-O Corp., Detroit.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Oliver Instrument Co., Adrian, Mich.

GRINDING MACHINES, THREAD

Ex-Cell-O Corporation, Detroit.
Jones & Lamson Mch. Co., Springfield, Vt.

GRINDING MACHINES, UNIVERSAL, FOR SHARPENING CUTTERS, REAMERS, HOBS, ETC.

Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence.
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Continental Machines, Inc., Minneapolis, Minn.
Fellows Gear Shaper Co., Sprigfield, Vt. (Helical Gear Shaper Cutters).
Gallmeyer & Livingston Co., Grand Rapids, Mich.

Landis Tool Co., Waynesboro, Pa.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Norton Co., Worcester, Mass.
Oliver Instrument Co., Adrian, Mich.
Pratt & Whitney Co., West Hartford, Conn.
Thompson Grinder Co., Springfield, O.
Union Twist Drill Co., Athol, Mass.

GRINDING MACHINES, WORM
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., West Hartford, Conn.

GRINDING WHEELS
Bakelite Corp., 30 East 42nd St., New York.
Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Blanchard Mch. Co., Cambridge, Mass.
Carborundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass.

GUARDS FOR PUNCH PRESSES, SAFETY
Taylor-Shantz, Inc., Rochester, N. Y.

HAMMERS, DROP
Morgan Engineering Co., Alliance, O.

HAMMERS, PNEUMATIC
Madison-Kipp Corp., Madison, Wis.

HAMMERS, PORTABLE ELECTRIC
Black & Decker Mfg. Co., Towson, Md.
Van Dorn Electric Tools, Towson, Md.

HAMMERS, POWER
Quickwork-Whiting Div. of Whiting Corp., Harvey, Ill.

HAMMERS, SOFT
Greene, Tweed & Co., Bronx Blvd. & 238th St., New York.

HAMMERS, STEAM
Sellers, Wm., & Co., Inc., Philadelphia.

HANGERS, SHAFT
Boston Gear Works, Inc., No. Quincy, Mass.
Hill Acme Co., Cleveland, O.
Hyatt Bearings Div. General Motors Sales Corp., Harrison, N. J.
Sellers, Wm., & Co., Inc., Philadelphia.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago.
S K F Industries, Inc., Philadelphia.
Standard Pressed Steel Co., Jenkintown, Pa.

HARDENING EQUIPMENT, INDUCTION
Ohio Crankshaft Co., Cleveland.

HARDNESS TESTING INSTRUMENTS
Shore Instrument & Mfg. Co., Jamaica, N. Y.
Wilson Mechanical Instrument Co., Inc., 382 Concord Ave., New York.

HEAT TREATMENT OF STEEL
Bennett Metal Treating Co., Elmwood, Conn.
Davis Boring Tool Div., St. Louis, Mo.
National-Erie Corp., 1521 Raspberry St., Erie, Pa.
Ohio Gear Co., Cleveland, O.
Pittsburgh Gear & Mch. Co., Pittsburgh.

HOBBING MACHINES
See Gear Cutting Machines, Helical and Spur (Hob); and Gear Cutting Machines, Worm and Worm Wheels.

HOBS
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
Lees-Bradner Co., Cleveland.
National Twist Drill & Tool Co., Detroit.
New Jersey Gear & Mfg. Co., Newark, N. J.
Union Twist Drill Co., Athol, Mass.

HOIST HOOKS
Bethlehem Steel Co., Bethlehem, Pa.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

HOISTING AND CONVEYING MACHINERY
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HOISTS, AIR
Hanna Engineering Wks., 1765 Elston Ave., Chicago.
Ingersoll-Rand Co., 11 Broadway, New York.
Norton Engrg. Wks., Detroit.

HOISTS, CHAIN, ETC.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

HOISTS, ELECTRIC
Philadelphia Gear Works, Philadelphia.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HONES
Carborundum Co., Niagara Falls, N. Y.
Micromatic Hone Corp., Detroit, Mich.
Moline Tool Co., Moline, Ill
Sunnen Products Co., St. Louis, Mo.

HONING MACHINES, CYLINDER
Barnes Drill Co., Rockford, Ill.
Barnes, W. F., & John, Co., Rockford, Ill.
Micromatic Hone Corp., Detroit, Mich.
Moline Tool Co., Moline, Ill.
Sunnen Products Co., St. Louis, Mo.

HONING MACHINES, EXTERNAL
Barnes Drill Co., Rockford, Ill.
International Machine Tool Corp. (Foster Div.), Elkhart, Ind.
Micromatic Hone Corp., Detroit, Mich.

HYDRAULIC MACHINERY, TOOLS AND EQUIPMENT
Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Farquhar, A. B., Co., Ltd., York, Pa.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
National-Erie Corp., 1521 Raspberry St., Erie, Pa.
Sundstrand Mch. Tool Co., Rockford, Ill.
Watson-Stillman Co., Roselle, N. J.

HYDRAULIC POWER UNITS
Barnes, W. F., & John, Co., Rockford, Ill.

HYDRAULIC TOOL HEADS OR POWER UNITS
Ex-Cell-O Corporation, Detroit.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
New Britain-Gridley Machine Div., New Britain Machine Co., New Britain, Conn.

INDEX CENTERS
Abrasive Mch. Tool Co., East Providence, R. I.
Brown & Sharpe Mfg. Co., Providence.
Kempsmith Mch. Co., Milwaukee, Wis.

INDEXING AND SPACING FIXTURES
Hartford Special Mchry. Co., Hartford, Conn.

INDICATORS, DIAL
Ames, B. C., Co., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence.
Federal Products Corp., Providence, R. I.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Starrett, L. S., Co., Athol, Mass.

INDICATORS, SPEED
Brown & Sharpe Mfg. Co., Providence.
Starrett, L. S., Co., Athol, Mass.
Veeder-Root, Inc., Hartford, Conn.

INDICATORS, TEST
Brown & Sharpe Mfg. Co., Providence.
Federal Products Corp., Providence, R. I.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Starrett, L. S., Co., Athol, Mass.

INGOTS, MANGANESE, BRONZE AND BRASS
Cramp Brass & Iron Foundries Co., Philadelphia, Pa.

INTENSIFIERS, HYDRAULIC
Baldwin-Southwark Corp., Philadelphia, Pa.
Farquhar, A. B., Co., Ltd., York, Pa.
Morgan Engineering Co., Alliance, O.
Watson-Stillman Co., Roselle, N. J.

JACKS, PLANER
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.

JIG BORER
See Boring Machines, Jig.

JIGS AND FIXTURES
Columbus Die, Tool & Mch. Co., Columbus, O.
Ex-Cell-O Corporation, Detroit.
Hartford Special Mchy. Co., Hartford, Conn.
Modern Mch. Corp., Brooklyn, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.

KEYS, WOODRUFF TYPE
Whitney Chain & Mfg. Co., Hartford, Conn.

KEYSEATERS
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis Keyseater Co., Rochester, N. Y.
Lapointe Machine Tool Co., Hudson, Mass.

KNURL HOLDERS
Graham Mfg. Co., Inc., E. Greenwich, R. I.
Pratt & Whitney Co., West Hartford, Conn.

KNURLING TOOLS
American Swiss File & Tool Co., Elizabeth, N. J.
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Graham Mfg. Co., Inc., E. Greenwich, R. I.
Pratt & Whitney Co., West Hartford, Conn.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

LAPPING MACHINES
Cincinnati Grinders, Inc., Cincinnati.
Ex-Cell-O Corp., Detroit.
Fellows Gear Shaper Co., Springfield, Vt.
Norton Co., Worcester, Mass.

LATHE ATTACHMENTS
American Tool Wks. Co., Cincinnati.
Atlas Press Co., Kalamazoo, Mich.
Bradford Machine Tool Co., Cincinnati, O.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati.
Gisholt Mch. Co., Madison, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Tool Co., Cincinnati.
McCrosky Tool Corp., Meadville, Pa.
Monarch Mch. Tool Co., Sidney, O.
Pratt & Whitney Co., West Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
South Bend Lathe Wks., Inc., South Bend, Ind.
Springfield Mch. Tool Co., Springfield, O.
Sundstrand Mch. Tool Co., Rockford, Ill.
United States Electrical Tool Co., Cincinnati.
Warner & Swasey Co., Cleveland.

LATHE DOGS
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Ready Tool Co., Bridgeport, Conn.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

LATHES, AUTOMATIC
Baird Mch. Co., Bridgeport, Conn.
Gisholt Mch. Co., Madison, Wis.
Goss & DeLeeuw Mch. Co., New Britain, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Tool Co., Cincinnati.
Monarch Mch. Tool Co., Sidney, O.
National Acme Co., Cleveland.
New Britain-Gridley Machine Div., New Britain Machine Co., New Britain, Conn.
Potter & Johnston Mch. Co., Pawtucket, R. I.
Pratt & Whitney Co., West Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.

LATHES, AXLES AND SHAFT
Consolidated Mch. Tool Corp., Rochester, N. Y.
Lodge & Shipley Mch. Tool Co., Cincinnati.
Sellers, Wm., & Co., Inc., Philadelphia.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.

LATHES, BENCH
Ames, B. C., Co., Waltham, Mass.
Atlas Press Co., Kalamazoo, Mich.
Elgin Tool Wks., Inc., Berteau & Ravenswood Ave., Chicago.
Hardinge Brothers, Inc., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Pratt & Whitney Co., West Hartford, Conn.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Sheldon Machine Co., 1627 N. Kilbourn Ave., Chicago, Ill.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
South Bend Lathe Wks., Inc., South Bend, Ind.

LATHES, BORING
Gisholt Mch. Co., Madison, Wis.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Tool Co., Cincinnati.

LATHES, BRASS WORKERS'
Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Inc., Cleveland, O.
Gisholt Mch. Co., Madison, Wis.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland.

LATHES, CRANKSHAFT
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Sundstrand Mch. Tool Co., Rockford, Ill.

LATHES, DOUBLE-END
Consolidated Mch. Tool Corp., Rochester, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.

LATHES, ENGINE AND TOOLROOM
Acme Machine Tool Co., Cincinnati.
American Tool Wks. Co., Cincinnati.
Atlas Press Co., Kalamazoo, Mich.
Axelson Manufacturing Co., Los Angeles, Calif.
Bradford Machine Tool Co., Cincinnati, O.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Co., Cincinnati.
Monarch Mch. Tool Co., Sidney, O.
Morey Machinery Co., Inc., 410 Broome St., New York.
Pratt & Whitney Co., West Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Rockford Mch. Tool Co., Rockford, Ill.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Machine Co., 1627 N. Kilbourn Ave., Chicago, Ill.
Simmons Machine Tool Corp., Albany, N. Y.
South Bend Lathe Wks., Inc., South Bend, Ind.
Springfield Mch. Tool Co., Springfield, O.

LATHES, EXTENSION BED AND GAP
Cincinnati Lathe & Tool Co., Oakley, Cincinnati.
Gisholt Mch. Co., Madison, Wis.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Tool Co., Cincinnati.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
South Bend Lathe Wks., Inc., South Bend, Ind.
Warner & Swasey Co., Cleveland.

LATHES, GUN
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Lodge & Shipley Mch. Tool Co., Cincinnati.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.

LATHES, MANUFACTURING TYPE
Lipe, W. C., Inc., Syracuse, N. Y.
Lodge & Shipley Mch. Tool Co., Cincinnati.

LATHES, SHELL TRIMMING AND THREAD ROLLING
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

LATHES, SPINNING
See Chucking Machines.

LATHES, TOOLROOM
See Lathes, Engine and Toolroom.

LATHES, TURRET
Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Inc., Cleveland, O.
Bullard Company, Bridgeport, Conn.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati.
Gisholt Mch. Co., Madison, Wis.
Hardinge Brothers, Inc., Elmira, N. Y. (Bench or Cabinet Mounting).
International Mch. Tool Co., Inc., Indianapolis, Ind.
Jones & Lamson Mch. Co., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
National Acme Co., Cleveland.
Morey Machinery Co., Inc., 410 Broome St., New York, N. Y.
Potter & Johnston Mch. Co., Pawtucket, R. I.

Production Machine Co., Greenfield, Mass.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Simmons Machine Tool Corp., Albany, N. Y.
South Bend Lathe Wks., Inc., South Bend, Ind.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland.

LATHES, TURRET AUTOMATIC
Potter & Johnston Mch. Co., Pawtucket, R. I.

LATHES, VERTICAL TURRET
Bullard Company, Bridgeport, Conn.

LEVELS
Pratt & Whitney Co., West Hartford, Conn.
Starrett, L. S., Co., Athol, Mass.
Universal Boring Mch. Co., Hudson, Mass.

LUBRICANTS, INCLUDING EXTREME PRESSURE (E. P.) MACHINERY LUBRICANTS
Gulf Oil Corp., Pittsburgh, Pa.
Lubri-Zol Corp., Cleveland.
Shell Oil Co., Inc., New York, St. Louis, San Francisco.
Socony Vacuum Oil Co., Inc., 26 Broadway, New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago.
Stuart, D. A., Oil Co., Ltd., 2727 So. Troy St., Chicago, Ill.
Sun Oil Co., Philadelphia.
Texas Co., 135 E. 42nd St., New York.
Tide Water Associated Oil Co., 17 Battery Place, New York.

LUBRICATING SYSTEMS
Farval Corp., Cleveland.
Madison-Kipp Corp., Madison, Wis.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.

MACHINISTS' SMALL TOOLS
See Calipers, Hammers, Wrenches, Drills, Taps, etc.

MAGNESIUM
Dow Chemical Co., Midland, Mich.

MANDRELS
See Arbors and Mandrels.

MEASURING MACHINES, PRECISION
Federal Products Corp., Providence, R. I.
Hanson-Whitney Mch. Co., Hartford, Conn.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Pratt & Whitney Co., West Hartford, Conn.

METALS, BEARING
See Bearings, Bronze, Babbitt, etc., and Bushings, Brass, Bronze, etc.

METALS, PERFORATED
Chicago Perforating Co., 2445 W. 24th Place, Chicago.

METERS (See Recording Instruments).

MICROMETERS
Brown & Sharpe Mfg. Co., Providence.
Davis & Thompson Co., Milwaukee, Wis.
Pratt & Whitney Co., West Hartford, Conn.
Starrett, L. S., Co., Athol, Mass.

MILLING ATTACHMENTS
Brown & Sharpe Mfg. Co., Providence.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Elgin Tool Wks., Inc., Berteau & Ravenswood Ave., Chicago.
Kearney & Trecker Corp., Milwaukee, Wis.
Kempsmith Mch. Co., Milwaukee, Wis.
Reed-Prentice Corp., Worcester, Mass.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Sundstrand Machine Tool Co., Rockford, Ill.
Van Norman Mch. Tool Co., Springfield, Mass.

MILLING MACHINES, AUTOMATIC
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Kearney & Trecker Corp., Milwaukee, Wis.
Sundstrand Machine Tool Co., Rockford, Ill.
U. S. Tool Company, Inc., Ampere, N. J.

MILLING MACHINES, BENCH
Ames, B. C., Co., Waltham, Mass.
Atlas Press Co., Kalamazoo, Mich.
Hardinge Brothers, Inc., Elmira, N. Y. (Bench or Pedestal Type).
Pratt & Whitney Co., West Hartford, Conn.
Sundstrand Machine Tool Co., Rockford, Ill.

MILLING MACHINES, CIRCULAR CONTINUOUS
Consolidated Machine Tool Corp., Rochester, N. Y.
Davis & Thompson Co., Milwaukee, Wis.
Kearney & Trecker Corp., Milwaukee, Wis.
Sundstrand Machine Tool Co., Rockford, Ill.

MILLING MACHINES, DIE SINKING
See Die Sinking Machines.

MILLING MACHINES, DUPLEX
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Kearney & Trecker Corp., Milwaukee, Wis.

MILLING MACHINES, HAND
Frew Machine Co., Philadelphia.
Sundstrand Machine Tool Co., Rockford, Ill.
Van Norman Mch. Tool Co., Springfield, Mass.

MILLING MACHINES, HORIZONTAL, PLAIN AND UNIVERSAL
Brown & Sharpe Mfg. Co., Providence.
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Continental Machines, Inc., Minneapolis, Minn.
Douglas Mchy. Co., Inc., 150 Broadway, New York.
Frew Machine Co., Philadelphia.
Kearney & Trecker Corp., Milwaukee, Wis.
Kempsmith Mch. Co., Milwaukee, Wis.
Machinery Mfg. Co., Los Angeles, Calif.
Ohio Machine Tool Co., Kenton, O.
Simmons Machine Tool Corp., Albany, N. Y.
Sundstrand Machine Tool Co., Rockford, Ill.
Van Norman Mch. Tool Co., Springfield, Mass.

MILLING MACHINES, LINCOLN TYPE
Brown & Sharpe Mfg. Co., Providence.
Sundstrand Machine Tool Co., Rockford, Ill.

MILLING MACHINES, PLANER TYPE
Cincinnati Planer Co., Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Kearney & Trecker Corp., Milwaukee, Wis.
Sellers, Wm., & Co., Inc., Philadelphia.
Stokerunit Corp., Milwaukee, Wis.

MILLING MACHINES, UNIVERSAL
Brown & Sharpe Mfg. Co., Providence.
Continental Machines, Inc., Minneapolis, Minn.
Gorton Machine Co., Racine, Wis.
Kearney & Trecker Corp., Milwaukee, Wis.

MILLING MACHINES, VERTICAL
Brown & Sharpe Mfg. Co., Providence.
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Continental Machines, Inc., Minneapolis, Minn.
Gorton Machine Co., Racine, Wis.
Kearney & Trecker Corp., Milwaukee, Wis.
Machinery Mfg. Co., Los Angeles, Calif.
Pratt & Whitney Co., West Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Sundstrand Machine Tool Co., Rockford, Ill.

MODEL AND EXPERIMENTAL WORK
See Special Machinery and Tools.

MOLD AND DIE COPYING MACHINES
Gorton Machine Co., Racine, Wis.

MOLDING MACHINES, PLASTIC PRODUCTS
Reed-Prentice Corp., Worcester, Mass.
Watson-Stillman Co., Roselle, N. J.

MOLYBDENUM
Climax Molybdenum, 500 Fifth Ave., New York.

MOTORS, ELECTRIC
Baldor Electric Co., St. Louis, Mo.
Dumore Co., Racine, Wis.
General Electric Co., Schenectady, N. Y.
Janette Mfg. Co., 556 W. Monroe St., Chicago.
Reliance Electric & Engrg. Co., Cleveland.
Van Dorn Electric Tools, Towson, Md.
Wagner Electric Co., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., E. Pittsburgh.

MULTIPLE-SLIDE FORMING MACHINES
Baird Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., Ampere, N. J.

NIBBLING MACHINES
Gray Machine Co., Philadelphia.
Schatz Mfg. Co., Poughkeepsie, N. Y.

NICKEL
International Nickel Co., 67 Wall St., New York.

NIPPLE THREADING MACHINERY
Landis Mch. Co., Inc., Waynesboro, Pa.
Murchey Mch. & Tool Co., Detroit.
Oster Manufacturing, Cleveland, O.

NUT SETTING EQUIPMENT
See Screw Driving and Nut Setting Equipment.

NUT TAPPERS
See Bolt and Machinery.

NUTS, COLD FORGED, WING AND CAP
Parker-Kalon Corp., 200 Varick St., New York.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

OIL CUPS
Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago.
Trico Fuse Mfg. Co., Milwaukee, Wis.

OIL GROOVERS
Fischer Mch. Co., Philadelphia, Pa.
Hanson-Whitney Mch. Co., Hartford, Conn.

OIL HOLE COVERS
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago.

OILERS AND LUBRICATORS
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago.
Madison-Kipp Corp., Madison, Wis.
Trico Fuse Mfg. Co., Milwaukee, Wis.

OILS, CUTTING
Gulf Oil Corp., Pittsburgh, Pa.
Sun Oil Co., Philadelphia.
Texas Co., 135 E. 42nd St., New York.
Tide Water Associated Oil Co., 17 Battery Place, New York.

OILS, LUBRICATING
Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Gulf Oil Corp., Pittsburgh, Pa.
Shell Oil Co., Inc., New York, St. Louis, San Francisco.
Socony Vacuum Oil Co., Inc., 26 Broadway, New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago.
Stuart, D. A., Oil Co., Ltd., 2727 So. Troy St., Chicago, Ill.
Sun Oil Co., Philadelphia.
Texas Co., 135 E. 42nd St., New York.
Tide Water Associated Oil Co., 17 Battery Place, New York.

OILS, QUENCHING AND TEMPERING
Gulf Oil Corp., Pittsburgh, Pa.
Shell Oil Co., Inc., New York, St. Louis, San Francisco.
Standard Oil Co., (Indiana), 910 S. Michigan Ave., Chicago.
Stuart, D. A., Oil Co., Ltd., 2727 So. Troy St., Chicago, Ill.

OILS, SOLUBLE—See Compounds, Cutting, Grinding, Metal Drawing, etc.

PACKING, LEATHER, METAL, RUBBER, ASBESTOS, ETC.
Garlock Packing Co., Palmyra, N. Y.
Greene, Tweed & Co., Bronx Blvd. & 238th St., New York.
Watson-Stillman Co., Roselle, N. J.

PARALLELS
Brown & Sharpe Mfg. Co., Providence.
Johansson Div., Ford Motor Co., Dearborn, Mich.
Starrett, L. S., Co., Athol, Mass.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Walker, O. S., Co., Inc., Worcester, Mass.

PATTERNS, WOOD
Mummert-Dixon Co., Hanover, Pa.

PHOSPHOR BRONZE—See Bronze.

PILLOW BLOCKS
Hill Acme Co., Cleveland, O.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Norma-Hoffmann Bearing Corp., Stamford, Conn.
Shafer Bearing Corp., 35 E. Wacker Drive, Chicago.
S K F Industries, Inc., Philadelphia.
Standard Pressed Steel Co., Jenkintown, Pa.

PIPE CUTTING AND THREADING MACHINES
Foote-Burt Co., Cleveland.
Landis Mch. Co., Inc., Waynesboro, Pa.
Murchey Mch. & Tool Co., Detroit.
Oster Manufacturing, Cleveland, O.
Peerless Machine Co., 1613 Racine St., Racine, Wis.

PIPE, STEEL
Bethlehem Steel Co., Bethlehem, Pa.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

PIPE TONGS
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

PLANER ATTACHMENTS
Cincinnati Planer Co., Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Hanson-Whitney Mch. Co., Hartford, Conn.

PLANERS
Baldwin-Southwark Corp., Philadelphia, Pa.
Cincinnati Planer Co., Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y. (Incl. Plate, Rotary & Crank Types).
Ohio Machine Tool Co., Kenton, O.
Rockford Mch. Tool Co., Rockford, Ill.
Sellers, Wm., & Co., Inc., Philadelphia.

PLANERS, OPEN-SIDE
Cincinnati Planer Co., Cincinnati.

PLASTICS AND PLASTIC PRODUCTS
Bakelite Corp., 30 East 42nd St., New York.

PLATE ROLLS
Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., Cleveland, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St. Chicago.
Schatz Mfg. Co., Poughkeepsie, N. Y.

PLATES, SURFACE
Brown & Sharpe Mfg. Co., Providence.
Jones Machine Tool Works, Inc., Philadelphia, Pa.
Rotor Tool Co., Cleveland, O.
South Bend Tool & Die Co., South Bend, Ind.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
U. S. Tool Company, Inc., Ampere, N. J.

PNEUMATIC EQUIPMENT
Airgrip Chuck Div. Anker-Holth Mfg. Co., Port Huron, Mich.
Hanna Engineering Wks., 1765 Elston Ave., Chicago.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Ingersoll-Rand Co., 11 Broadway, New York.

POLISHING LATHES AND MACHINES

Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Continental Machines, Inc., Minneapolis, Minn.
Gardner Machine Co., Beloit, Wis.
Production Mch. Co., Greenfield, Mass.
Sundstrand Mch. Tool Co., Rockford, Ill.
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tools, Towson, Md.

POLISHING TOOLS, PORTABLE

Stow Mfg. Co., Binghamton, N. Y.
Strand, N. A., & Co., 5001 N. Wolcott Ave., Chicago.

PORTABLE ELECTRIC DRILLS, REAMERS, TAPPERS, ETC.

Black & Decker Mfg. Co., Towson, Md.
Van Dorn Electric Tools, Towson, Md.

PRESSES, ARBOR

Atlas Press Co., Kalamazoo, Mich.
Baldwin-Southwark Corp., Philadelphia, Pa.
Canedy-Otto Mfg. Co., Chicago, Heights, Ill.
Famco Machine Co., Racine, Wis.
Farquhar, A. B., Co., Ltd., York, Pa.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Sheldon Machine Co., 1627 N. Kilbourn Ave., Chicago, Ill.
Watson-Stillman Co., Roselle, N. J.
Wilson, K. R., Buffalo, N. Y.

PRESSES, BROACHING

American Broach & Mch. Co., Ann Arbor, Mich.
Ferracute Machine Co., Bridgeton, N. J.
Lapointe Machine Tool Co., Hudson, Mass.
V & O Press Co., Hudson, N. Y.
Watson-Stillman Co., Roselle, N. J.

PRESSES, EXTRUSION

Watson-Stillman Co., Roselle, N. J.

PRESSES, FOOT

Baird Machine Co., Bridgeport, Conn.
Etna Machine Co., Toledo, O.
Famco Machine Co., Racine, Wis.
Ferracute Machine Co., Bridgeton, N. J.
Niagara Machine & Tool Wks., Buffalo, N. Y.
V & O Press Co., Hudson, N. Y.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

PRESSES, FORGING

Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Clearing Mch. Co., 6499 W. 65th St., Chicago.
Cleveland Punch & Shear Works Co., Cleveland, O.
Farquhar, A. B., Co., Ltd., York, Pa.
Ferracute Machine Co., Bridgeton, N. J.
Henry & Wright Mfg. Co., Hartford, Conn.
Morgan Engineering Co., Alliance, O.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Schatz Mfg. Co., Poughkeepsie, N. Y.
V & O Press Co., Hudson, N. Y.
Watson-Stillman Co., Roselle, N. J.
Zeh & Hahnemann Co., Newark, N. J.

PRESSES, HYDRAULIC

American Broach & Mch. Co., Ann Arbor, Mich.
Atlas Press Co., Kalamazoo, Mich.
Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Clearing Mch. Co., 6499 W. 65th St., Chicago.
Denison Engineering Co., Columbus, O.
Farquhar, A. B., Co., Ltd., York, Pa.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Lapointe Machine Tool Co., Hudson, Mass.
Morgan Engineering Co., Alliance, O.
National-Erie Corp., 1521 Raspberry St., Erie, Pa.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.
Watson-Stillman Co., Roselle, N. J.
Wilson, K. R., Buffalo, N. Y.

PRESSES, PERCUSSION

Wilson, K. R., Buffalo, N. Y.
Zeh & Hahnemann Co., Newark, N. J.

PRESSES, SCREW

Ferracute Machine Co., Bridgeton, N. J.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.
Zeh & Hahnemann Co., Newark, N. J.

PRESSES, SHEET METAL WORKING

Baldwin-Southwark Corp., Philadelphia, Pa.
Cincinnati Shaper Co., Cincinnati.
Clearing Machine Corp., 6499 W. 65th St., Chicago.
Cleveland Punch & Shear Works Co., Cleveland, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Farquhar, A. B., Co., Ltd., York, Pa.
Famco Machine Co., Racine, Wis.
Federal Press Co., Elkhart, Ind.
Ferracute Machine Co., Bridgeton, N. J.
Henry & Wright Mfg. Co., Hartford, Ct.
Johnson Mch. & Press Corp., Elkhart, Ind.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Quickwork-Whiting Div. of Whiting Corp., Harvey, Ill.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Steelweld Mchry. Div. of Cleveland Crane & Engrg. Co., Cleveland.
V & O Press Co., Hudson, N. Y.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.
Watson-Stillman Co., Roselle, N. J.
Zeh & Hahnemann Co., Newark, N. J.

PRESSES, STRAIGHTENING

Baldwin-Southwark Corp., Philadelphia, Pa.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Farquhar, A. B., Co., Ltd., York, Pa.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Jones Machine Tool Works, Inc., Philadelphia, Pa.
Morgan Engineering Co., Alliance, O.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Watson-Stillman Co., Roselle, N. J.

PROFILING MACHINES

Consolidated Mch. Tool Corp., Rochester, N. Y.
Frew Machine Co., Philadelphia.
Gorton Machine Co., Racine, Wis.
Leland-Gifford Co., Worcester, Mass.
Morey Machinery Co., Inc., 410 Broome St., New York, N. Y.
Pratt & Whitney Co., West Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.

PULLEYS

Boston Gear Works, Inc., No. Quincy, Mass.
Continental Machines, Inc., Minneapolis, Minn.
Hill Acme Co., Cleveland.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Sellers, Wm., & Co., Inc., Philadelphia.

PULLEYS, FRICTION CLUTCH

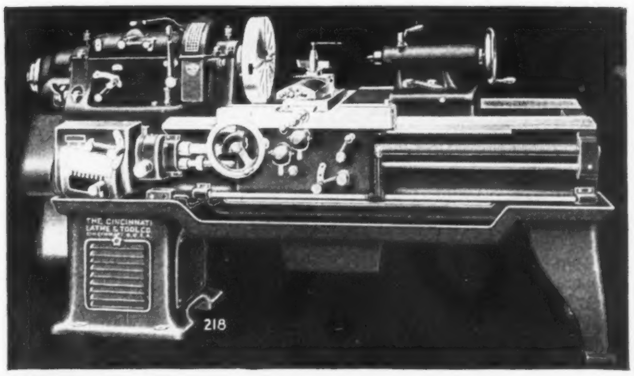
Brown & Sharpe Mfg. Co., Providence.
Hill Acme Co., Cleveland, O.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.

PUMPS, COOLANT, LUBRICANT AND OIL

Brown & Sharpe Mfg. Co., Providence.
Ingersoll-Rand Co., 11 Broadway, New York.
Pioneer Engineering & Mfg. Co., Detroit, Mich.
Ruthman Machinery Co., Cincinnati.
Tuthill Pump Co., 909 East 95th St., Chicago.
Viking Pump Co., Cedar Falls, Iowa.

PUMPS, HYDRAULIC

Baldwin-Southwark Corp., Philadelphia, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Brown & Sharpe Mfg. Co., Providence.
Ingersoll-Rand Co., 11 Broadway, New York.
Lapointe Machine Tool Co., Hudson, Mass.
Racine Tool & Mch. Co., Racine, Wis.



14" to 30" SIZES

12 or 24 Speeds 32 to 96 Threads and Feeds

EXTRA HEAVY BED WIDE WAYS

WRITE FOR COMPLETE CATALOG

GEARED TO TODAY'S NEEDS

Gears are the heart of a lathe. In Cincinnati Lathes all gears are made of special manganese chrome steel, heat treated in oil and ground. A unique tooth form, cut with special cutters, prevents gear marks from appearing on the work. Similar care in all other construction features results in a lathe capable of precision work to the most exacting standards.

Specialists Over 35 Years

THE CINCINNATI LATHE & TOOL CO.
OAKLEY, CINCINNATI, OHIO, U. S. A.

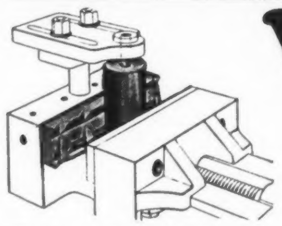


Fig. 3. V-Jaw Holds Round Work Vertical and Horizontal.

VISE

With and Without Jig Attachments

FOR DRILL PRESS. Often used on Miller, Shaper, Planer.

Jaws 6", 9" and 12" Long

Flanged around bottom for bolting down, with three slots at large end, not shown.

All Vises are drilled to take Jig Attachments. These holes are convenient for attaching stops.

The Attachments mean much duplicate drilling without costly jigs.

ANY VISE WILL PAY

Send for Circulars

THE GRAHAM MFG., CO. Inc.
EAST GREENWICH, R. I.

Fig. 2. Without Jig Attachments

WON'T SCORE! WON'T BURN! WON'T LOSE THEIR TEMPER!

. . . AND WILL OUTLAST TEN CARBON CENTERS

BECAUSE RED-E CENTERS HAVE HIGH SPEED STEEL ENDS!

RED-E TOOLS

THE READY TOOL CO.
550 IRANISTAN AVE.
BRIDGEPORT, CONN.

So firm and steady that scales are tested on them!

HALLOWELL STEEL BENCHES

Pat'd. and Pat's. Pending
Fig. 732. Drawer is extra.

Scale testing requires an absolutely rigid working surface . . . and this manufacturer installed "Hallowell" Benches—several hundred feet, in fact—to make sure of it.

The inherent steadiness of all "Hallowell" Benches is insured by correct design and extra strong bracing . . . *you'll find no skimping of materials in order to save steel and weight.* And this built-in steadiness makes bolting to the floor unnecessary . . . a very popular advantage!

Note also the combination steel and laminated wood top on the bench in the foreground. Your choice of permanently smooth and durable tops of steel, laminated wood or Masonite is another "Hallowell" feature.

Standardized construction permitting easy movability for flexible shop arrangements . . . easy to keep clean . . . *these are added advantages of the famous "Hallowell" Line.*

More than 1300 styles and models stocked to meet your needs exactly *in less time and at less cost than necessary to build your own!* Free bulletin gives details . . . write now.

Fig. 936
Pat'd. and Pat's. Pending

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. Box 22
BRANCHES
BOSTON · DETROIT · INDIANAPOLIS · CHICAGO · ST. LOUIS · SAN FRANCISCO

Sundstrand Mch. Tool Co., Rockford, Ill.
Tuthill Pump Co., 909 East 95th St., Chicago.
Viking Pump Co., Cedar Falls, Iowa.
Watson-Stillman Co., Roselle, N. J.

PUMPS, PNEUMATIC
Ingersoll-Rand Co., 11 Broadway, New York.

PUMPS, ROTARY
Pioneer Engineering & Mfg. Co., Detroit, Mich.
Tuthill Pump Co., 909 East 95th St., Chicago.
Viking Pump Co., Cedar Falls, Iowa.

PUNCHES AND DIES
See Dies, Sheet Metal, etc.

PUNCHES, CENTERING
Cleveland Punch & Shear Works Co., Cleveland, O.

PUNCHING MACHINERY
Cincinnati Shaper Co., Cincinnati.
Cleveland Punch & Shear Works Co., Cleveland, O.
Consolidated Machine Tool Corp., Rochester, N. Y.
Ferracute Machine Co., Bridgeton, N. J.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Steelweld Mchry. Div. of Cleveland Crane & Engrg. Co., Cleveland.
Watson-Stillman Co., Roselle, N. J.
Wiedemann Machine Co., Philadelphia.

PUNCHING AND RIVETING MACHINES
Hannifin Mfg. Co., Chicago.

PYROMETERS
Leeds & Northrup Co., Philadelphia.
Shore Instrument & Mfg. Co., Jamaica, N. Y.

RACKS, GEAR, CUT
Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Boston Gear Works, Inc., No. Quincy, Mass.
Brown & Sharpe Mfg. Co., Providence.
Fellows Gear Shaper Co., Springfield, Vt.
Hartford Special Mchry. Co., Hartford, Conn.
Massachusetts Gear & Tool Co., Woburn, Mass.
Meisel Press Mfg. Co., Boston, Mass.
Philadelphia Gear Works, Philadelphia.
Stahl Gear & Machine Co., Cleveland.

REAMER HOLDERS
Gairing Tool Co., Detroit.
Gisholt Machine Co., Madison, Wis.
Landis Mch. Co., Inc., Waynesboro, Pa.
McCrosky Tool Corp., Meadville, Pa.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Warner & Swasey Co., Cleveland.

REAMERS
Barber-Colman Co., Rockford, Ill.
Butterfield Div. Union Twist Drill Co., Derby Line, Vt.
Carboloy Co., Inc., Detroit.
Cleveland Twist Drill Co., Cleveland.
Columbus Die, Tool & Mch. Co., Columbus, O.
Davis Boring Tool Div., St. Louis, Mo.
Ex-Cell-O Corporation, Detroit.
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit.
Gammons-Hoaglund Co., Manchester, Conn.
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
Haynes Stellite Co., Kokomo, Ind.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
Lipe W. C., Inc., Syracuse, N. Y.
McCrosky Tool Corp., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill Co., Detroit.
Pratt & Whitney Co., West Hartford, Conn.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Union Twist Drill Co., Athol, Mass.

REAMERS, ADJUSTABLE
Barber-Colman Co., Rockford, Ill.
Carboloy Co., Inc., Detroit.
Cleveland Twist Drill Co., Cleveland.
Davis Boring Tool Div., St. Louis, Mo.
Ex-Cell-O Corporation, Detroit.
Gairing Tool Co., Detroit.
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
Madison Mfg. Co., Muskegon, Mich.
McCrosky Tool Corp., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., West Hartford, Conn.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Union Twist Drill Co., Athol, Mass.

REAMERS, TAPER PIN
Butterfield Div. Union Twist Drill Co., Derby Line, Vt.
Gammons-Hoaglund Co., Manchester, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Lipe, W. C., Inc., Syracuse, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., West Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

REAMING MACHINES
Van Norman Mch. Tool Co., Springfield, Mass.

RECORDING INSTRUMENTS FOR COUNTING
National Acme Co., Cleveland.

RECORDING INSTRUMENTS FOR ELECTRICITY
General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., Philadelphia.

RECORDING INSTRUMENTS FOR PRESSURE
Leeds & Northrup Co., Philadelphia.

RECORDING INSTRUMENTS FOR SPEED
Leeds & Northrup Co., Philadelphia.

RECORDING INSTRUMENTS FOR TEMPERATURE
Leeds & Northrup Co., Philadelphia.

REELS, STOCK, STANDARD AND AUTOMATIC
S. & S. Mch. Wks., 4541 W. Lake St., Chicago.
U. S. Tool Company, Inc., Ampere, N. J.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

REFRACTORIES, HEAT TREATING FURNACE
Norton Co., Worcester, Mass.

REGULATORS, TEMPERATURE
General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., Philadelphia.

REMOVERS, JAPAN, ENAMEL, ETC.
Oakite Products, Inc., 26 Thames St., New York.

RHEOSTATS
Allen-Bradley Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.

RIVET SETS
American Swiss File & Tool Co., Elizabeth, N. J.
Bethlehem Steel Co., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., Cleveland, O.

RIVETERS, HYDRAULIC
Bethlehem Steel Co., Bethlehem, Pa.
Hanna Engineering Wks., 1765 Elston Ave., Chicago.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Morgan Engineering Co., Alliance, O.

RIVETERS, PNEUMATIC
Grant Mfg. & Mch. Co., Bridgeport, Conn.
Hanna Engineering Wks., 1765 Elston Ave., Chicago.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Ingersoll-Rand Co., 11 Broadway, New York.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

RIVETING MACHINES
Grant Mfg. & Mch. Co., Bridgeport, Conn.
Hanna Engineering Wks., 1765 Elston Ave., Chicago.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.

RIVET-MAKING MACHINES
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

ROUTERS, PORTABLE
Onsrud Machine Works, Inc., 3940 Palmer St., Chicago.

RULES, STEEL
Brown & Sharpe Mfg. Co., Providence.
Starrett, L. S., Co., Athol, Mass.

RUST PREVENTIVE
Oakite Products, Inc., 26 Thames St., New York.

SAFETY GUARDS FOR PUNCH PRESSES
Taylor-Shantz, Inc., Rochester, N. Y.

SAND BLAST EQUIPMENT
See Blast Cleaning Equipment.

SANDERS
Black & Decker Mfg. Co., Towson, Md.
Carborundum Co., Niagara Falls, N. Y.
Delta Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York.
Rotor Tool Co., Cleveland, O.
Stow Mfg. Co., Binghamton, N. Y.
Sundstrand Mch. Tool Co., Rockford, Ill.
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tools, Towson, Md.
Walls Sales Corp., 96 Warren St., New York.

SAW BLADES, HACK
Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.
Starrett, L. S., Co., Athol, Mass.

SAW SHARPENING MACHINES
Covel Mfg. Co., Benton Harbor, Mich.
Earle Gear & Mch. Co., Philadelphia.
Huther Bros. Saw Mfg. Co., Inc., Rochester, N. Y.

SAWING MACHINES, CIRCULAR
Consolidated Mch. Tool Corp., Rochester, N. Y.
Earle Gear & Mch. Co., Philadelphia.
Etna Machine Co., Toledo, O.

SAWING MACHINES, FRICTION
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

SAWING MACHINES, METAL CUTTING BAND
Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.
Avey Drilling Mch. Co., Cincinnati, O.
Continental Machine, Inc., Minneapolis, Minn.
Delta Mfg. Co., Milwaukee, Wis.
Huther Bros. Saw Mfg. Co., Inc., Rochester, N. Y.
Racine Tool & Mch. Co., Racine, Wis.
Ryerson, Joseph T. & Son, Inc., 2558 W. 16th St., Chicago.
Tannewitz Works, Grand Rapids, Mich.

SAWING MACHINES, POWER HACK
Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.
Covel Mfg. Co., Benton Harbor, Mich.
Peerless Machine Co., 1613 Racine St., Racine, Wis.
Racine Tool & Mch. Co., Racine, Wis.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

SAWING MACHINES, WOOD
Delta Mfg. Co., Milwaukee, Wis.

SAWS, CIRCULAR METAL CUTTING
Consolidated Mch. Tool Corp., Rochester, N. Y.
Huther Bros. Saw Mfg. Co., Inc., Rochester, N. Y.
Illinois Tool Wks., 2501 No. Keeler Ave., Chicago.
National Twist Drill & Tool Co., Detroit.
Union Twist Drill Co., Athol, Mass.

SAWS, HOLE
Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.

SAWS, METAL CUTTING BAND
Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.
Delta Mfg. Co., Milwaukee, Wis.
DoAll Co., Inc., Des Plaines, Ill.
Huther Bros. Saw Mfg. Co., Inc., Rochester, N. Y.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Starrett, L. S., Co., Athol, Mass.

SAWS, PORTABLE ELECTRIC
Black & Decker Mfg. Co., Towson, Md.
Van Dorn Electric Tools, Towson, Md.

SAWS, SCREW SLOTTING
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Starrett, L. S., Co., Athol, Mass.
Union Twist Drill Co., Athol, Mass.

SCREW CUTTING TOOLS—See Taps and Dies.

SCREW DRIVING AND NUT SETTING EQUIPMENT
Black & Decker Mfg. Co., Towson, Md.
Errington Mechanical Laboratory, 200 Broadway, New York.
Haskins, R. G., Co., 617 S. California Ave., Chicago.
Ingersoll-Rand Co., 11 Broadway, New York.
Procunier Safety Chuck Co., 18 S. Clinton St., Chicago.
Stow Mfg. Co., Binghamton, N. Y.
Strand, N. A., & Co., 5001 N. Wolcott Ave., Chicago.
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tools, Towson, Md.

SCREW MACHINES, AUTOMATIC SINGLE AND MULTIPLE SPINDLE
Brown & Sharpe Mfg. Co., Providence.
Cleveland Automatic Machine Co., Cleveland, O.
Cone Automatic Machine Co., Inc., Windsor, Vt.
Foote-Burt Co., Cleveland, O.
Greenlee Bros. & Co., Rockford, Ill.
National Acme Co., Cleveland.
New Britain-Gridley Machine Div., New Britain Machine Co., New Britain, Conn.

SCREW MACHINES, HAND
See also Lathes, Turret.
Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Inc., Cleveland, O.
Brown & Sharpe Mfg. Co., Providence.
Gisholt Mch. Co., Madison, Wis.
Hardinge Brothers, Inc., Elmira, N. Y.
International Machine Tool Corp. (Foster Div.), Elkhart, Ind.
Jones & Lamson Machine Co., Springfield, Vt.
Rivett Lathe & Grinder, Inc., Brighton, Boston, Mass.
Simmons Machine Tool Corp., Albany, N. Y.
Warner & Swasey Co., Cleveland.

SCREW MACHINE TOOLS AND EQUIPMENT
Bardons & Oliver, Inc., Cleveland, O.
Brown & Sharpe Mfg. Co., Providence.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mch. Co., Madison, Wis.
Greenlee Bros. & Co., Rockford, Ill.
International Machine Tool Corp. (Foster Div.), Elkhart, Ind.
Jones & Lamson Machine Co., Springfield, Vt.
Landis Mch. Co., Inc., Waynesboro, Pa.
Murchey Mch. & Tool Co., Detroit.
National Acme Co., Cleveland.
New Britain-Gridley Machine Div., New Britain Machine Co., New Britain, Conn.
Potter & Johnston Machine Co., Pawtucket, R. I.
R & L Tools, Nicetown, Philadelphia.
Warner & Swasey Co., Cleveland.

SCREW MACHINE WORK
Eastern Mch. Screw Corp., New Haven, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland.
Standard Pressed Steel Co., Jenkintown, Pa.

SCREW PLATES
Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Butterfield Div. Union Twist Drill Co., Derby Line, Vt.
Card, S. W., Mfg. Co., Mansfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., West Hartford, Conn.
Winter Bros. Co., Wrentham, Mass.

SCREWS, CAP, SET, SAFETY SET AND MACHINE
Allen Mfg. Co., Hartford, Conn.
American Screw Co., Providence, R. I.
Central Screw Co., 3511 Shields Ave., Chicago.
Chandler Products Corp., Cleveland, O.
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corp., New Britain, Conn.
Holo-Krome Screw Corp., Hartford, Conn.

International Screw Co., Detroit, Mich.
Lamson & Sessions Co., Cleveland.
National Acme Co., Cleveland.
National Screw & Mfg. Co., Cleveland.
New England Screw Co., Keene, New Hampshire.
Parker, Chas., Co., Meriden, Conn.
Parker-Kalon Corp., 200 Varick St., New York.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Mfg. Co., 5700 W. Roosevelt Rd., Chicago.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Mfg. Co., Waterbury, Conn.
Shakeproof Lock Washer Co., 2553 N. Keeler Ave., Chicago.
Southington Hardware Co., Southington, Conn.
Standard Pressed Steel Co., Jenkintown, Pa.
Whitney Screw Corp., Nashua, N. H.

SCREWS, SELF-TAPPING DRIVE

Parker-Kalon Corp., 200 Varick St., New York.
Shakeproof Lock Washer Co., 2553 N. Keeler Ave., Chicago.

SCREWS, THUMB

American Screw Co., Providence, R. I.
Parker-Kalon Corp., 200 Varick St., New York.
Williams, J. H., & Co., 225 Lafayette St., New York.

SEALS AND RETAINERS, OIL OR GREASE

Garlock Packing Co., Palmyra, N. Y.
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago.

SEAMLESS STEEL TUBING

See Tubing, Seamless Steel.

SECOND-HAND MACHINERY, ETC.

Atlantic Machinery Corp., 149 Broadway, New York, N. Y.
Cincinnati Machinery & Supply Co., Cincinnati.
Eastern Machinery Co., Cincinnati.
Emerman, Louis E., & Co., 1761 Elston Ave., Chicago.
General Machinery Corp., Boston, Mass.
Hill Clarke Machinery Co., 649 Washington Blvd., Chicago.
Lang Machinery Co., Pittsburgh, Pa.
Miles Machinery Co., Saginaw, Mich.
Morey Mchry. Co., Inc., 410 Broome St., New York.
Simmons Machine Tool Corp., Albany, N. Y.
Wigglesworth Machinery Co., Cambridge, Mass.

SEPARATORS, CENTRIFUGAL OIL

National Acme Co., Cleveland.

SHAFTING, STEEL

Bethlehem Steel Co., Bethlehem, Pa.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Standard Pressed Steel Co., Jenkintown, Pa.
Union Drawn Steel Div., Massillon, O.
Union Twist Drill Co., Athol, Mass.

SHAFTING, STEEL TUBING FOR

National Tube Co. (U. S. Steel Co. Div.), Pittsburgh.

SHAFTS, FLEXIBLE

Haskins, R. G., Co., 617 S. California Ave., Chicago.
Stow Mfg. Co., Inc., Binghamton, N. Y.
Strand, N. A., & Co., 5001 N. Wolcott Ave., Chicago.

SHAFTS, HOLLOW BORED

American Hollow Boring Co., Erie, Pa.
Bethlehem Steel Co., Bethlehem, Pa.

SHAFTS, TURNED AND GROUND

Bethlehem Steel Co., Bethlehem, Pa.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Union Drawn Steel Div., Massillon, O.

SHAPERS

American Tool Wks., Co., Cincinnati.
Atlas Press Co., Kalamazoo, Mich.
Cincinnati Shaper Co., Cincinnati.
Lewis Machine Tool Co., Los Angeles, Calif.
Machinery Mfg. Co., Los Angeles, Calif.
Ohio Machine Tool Co., Kenton, O.
Onsrud Machine Works, Inc., 3940 Palmer St., Chicago.
Rockford Mch. Tool Co., Rockford, Ill.
Smith & Mills Co., Cincinnati.

SHAPERS, VERTICAL

Hanson-Whitney Mfg. Co., Hartford, Conn.
Jones Mch. Tool Works, Inc., Philadelphia, Pa.
Pratt & Whitney Co., West Hartford, Conn.

SHAPES, STRUCTURAL

Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Cramp Brass & Iron Foundries Co., Philadelphia, Pa.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.

SHEARING MACHINERY

Bethlehem Steel Co., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., Cleveland, O.
Cincinnati Shaper Co., Cincinnati.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Ferracute Machine Co., Bridgeton, N. J.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Morgan Engineering Co., Alliance, O.
Niagara Mch. & Tool Wks., Buffalo.
Quickwork-Whiting Div. of Whiting Corp., Harvey, Ill.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Watson-Stillman Co., Roselle, N. J.
Yoder Co., Cleveland, O.

SHEARS, ROTARY

Cleveland Punch & Shear Works Co., Cleveland, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Niagara Mch. & Tool Wks., Buffalo.
Quickwork-Whiting Div. of Whiting Corp., Harvey, Ill.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Union Twist Drill Co., Athol, Mass.

SHEARS, SQUARING

Cincinnati Shaper Co., Cincinnati.
Cleveland Punch & Shear Works Co., Cleveland, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Niagara Mch. & Tool Wks., Buffalo.
Schatz Mfg. Co., Poughkeepsie, N. Y.

SHEAVE WHEELS

Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.

SHEET METALS

Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Ingersoll Steel & Disc Div. Borg-Warner Corp., New Castle, Ind.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.

SHEETS, IRON AND STEEL

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.

SHEETS, PERFORATED
Chicago Perforating Co., 2445 W. 24th Place, Chicago.

SHIMS
Ohio Shim & Gasket Co., Cuyahoga Falls, O.

SINE BARS
Johansson Div., Ford Motor Co., Dearborn, Mich.
Starrett, L. S., Co., Athol, Mass.

SLEEVES
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., West Hartford, Conn.
Scully-Jones Co., 1903 S. Rockwell St., Chicago.
Union Twist Drill Co., Athol, Mass.

SLITTING MACHINES, SHEET METAL
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

SLOTTING MACHINES
Consolidated Mch. Tool Corp., Rochester, N. Y.
Douglas Mchy. Co., Inc., 150 Broadway, New York.
Jones Machine Tool Works, Inc., Philadelphia, Pa.
Rockford Mch. Tool Co., Rockford, Ill.
Sellers, Wm., & Co., Inc., Philadelphia.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

SOCKETS
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., West Hartford, Conn.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.
Union Twist Drill Co., Athol, Mass.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

SOLDER FOR ALUMINUM AND CAST IRON
Cramp Brass & Iron Foundries Co., Philadelphia, Pa.

SPECIAL MACHINERY AND TOOLS
Baird Machine Co., Bridgeport, Conn.
Baldwin-Southwark Corp., Philadelphia, Pa.
Barnes Drill Co., Rockford, Ill.
Barnes, W. F., & John, Co., Rockford, Ill.
Baush Machine Tool Co., Springfield, Mass.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Mch. Wks., Philadelphia.
Blanchard Machine Co., Cambridge, Mass.
Columbus Die, Tool & Machine Co., Columbus, O.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis Boring Tool Co., Inc., St. Louis, Mo.
Denison Engineering Co., Columbus, O.
Earle Gear & Mch. Co., Philadelphia.
Elgin Tool Wks., Inc., Berteau & Ravenswood Ave., Chicago.
Ex-Cell-O Corp., Detroit.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Gairing Tool Co., Detroit.
Gisholt Mch. Co., Madison, Wis.
Gorton Machine Co., Racine, Wis.
Grant Mfg. & Mch. Co., Bridgeport, Conn.
Greenlee Bros. & Co., Rockford, Ill.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Hartford Special Mchy. Co., Hartford, Conn.
Hill Acme Co., Cleveland, O.
Jones Machine Tool Works, Inc., Philadelphia, Pa.
Langelier Mfg. Co., Providence.
Lipe, W. C., Inc., Syracuse, N. Y.
Modern Machine Corp., Brooklyn, N. Y.
Moline Tool Co., Moline, Ill.
Morgan Engineering Co., Alliance, O.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland.
National-Erie Corp., 1521 Raspberry St., Erie, Pa.
National Twist Drill & Tool Co., Detroit.
New Britain-Gridley Machine Div., New Britain Machine Co., New Britain, Conn.
New Jersey Gear & Mfg. Co., Newark, N. J.
Niagara Mch. & Tool Wks., Buffalo.
Pioneer Engineering & Mfg. Co., Detroit, Mich.
Pratt & Whitney Co., West Hartford, Conn.
Reed-Prentice Corp., Worcester, Mass.
Root, B. M., Co., York, Pa.
Ruthman Machinery Co., Cincinnati.
S. & S. Mch. Works, 4541 W. Lake St., Chicago.
Sundstrand Machine Tool Co., Rockford, Ill.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Union Twist Drill Co., Athol, Mass.
U. S. Tool Company, Inc., Ampere, N. J.
V & O Press Co., Hudson, N. Y.
Waltham Mch. Wks., Waltham, Mass.

SPEED REDUCERS
Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Boston Gear Works, Inc., No. Quincy, Mass.
Cleveland Worm & Gear Co., Cleveland.
Cullman Wheel Co., Altgeld St., Chicago.
Davis & Thompson Co., Milwaukee, Wis.
Farrel-Birmingham Co., Inc., Buffalo, N. Y., and Ansonia, Conn.
Ganschow Gear Co., 16 N. Morgan St., Chicago.
General Electric Co., Schenectady, N. Y.
Grant Gear Works, Inc., Boston, Mass.
Janette Mfg. Co., 556 W. Monroe St., Chicago.
Jones W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

SPINDLES, GRINDING
Ex-Cell-O Corporation, Detroit.

SPINDLES, HOLLOW BORED
American Hollow Boring Co., Erie, Pa.

SPINNING LATHES
See Chucking Machines.

SPRING COILING AND FORMING MACHINERY
Baird Machine Co., Bridgeport, Conn.

SPRINGS, WIRE
American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Hunter Pressed Steel Co., Lansdale, Pa.

SPROCKET CHAINS
Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Boston Gear Works, Inc., No. Quincy, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Grant Gear Works, Inc., Boston, Mass.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia.

SPROCKETS
Atlantic Gear Works, Inc., 124 Lafayette St., New York.
Boston Gear Works, Inc., No. Quincy, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Grant Gear Works, Inc., Boston, Mass.
Hartford Special Mchry. Co., Hartford, Conn.
Jones, W. A., Fdry. & Mch. Co., 4409 W. Roosevelt Road, Chicago.
Morse Chain Co., Ithaca, N. Y.
National-Erie Corp., 1521 Raspberry St., Erie, Pa.
Philadelphia Gear Works, Philadelphia.
Whitney Chain & Mfg. Co., Hartford, Conn.

STAMPINGS, SHEET METAL
Shakeproof Lock Washer Co., 2553 N. Keeler Ave., Chicago, Ill.
Taylor-Shantz, Inc., Rochester, N. Y.

STAMPS, STEEL, AND MARKING DIES
Pittsburgh Stamp Co., Inc., Pittsburgh.

STEEL
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Carpenter Steel Co., Reading, Pa.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Jessop Steel Co., Washington, Pa.
Ingersoll Steel & Disc Div, Borg-Warner Corp., New Castle, Ind.
Monarch Steel Co., Indianapolis, Ind.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.
Timken Roller Bearing Co., Canton, O.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL ALLOYS
See Alloy-steels.

STEEL BARS
See Bars, Steel.

STEEL, COLD DRAWN
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Bethlehem Steel Co., Bethlehem, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Monarch Steel Co., Indianapolis, Ind.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL, COMPOSITE TOOL AND DIE
Jessop Steel Co., Washington, Pa.

STEEL, HIGH SPEED TOOL
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Cleveland Twist Drill Co., Cleveland.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Jessop Steel Co., Washington, Pa.
Latrobe Electric Steel Co., Latrobe, Pa.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL, MACHINE
Bethlehem Steel Co., Bethlehem, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Jessop Steel Co., Washington, Pa.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL, RUSTLESS
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Jessop Steel Co., Washington, Pa.

STEEL, STAINLESS
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.

Ingersoll Steel & Disc Div. Borg-Warner Corp., New Castle, Ind.
Jessop Steel Co., Washington, Pa.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL STOCK GROUND FLAT

Brown & Sharpe Mfg. Co., Providence.
Starrett, L. S., Co., Athol, Mass.

STEEL, STRIP AND SHEET

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Columbia Steel Co (U. S. Steel Corp. Div.), San Francisco, Cal.
Jessop Steel Co., Washington, Pa.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.
Thomas Steel Co., Warren, O.

STEEL, ZINC, TIN AND COPPER COATED STRIP

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Thomas Steel Co., Warren, O.

STELLITE

Haynes Stellite Co., Kokomo, Ind.

STOCKS, DIE

Butterfield Div. Union Twist Drill Co., Derby Line, Vt.
Card, S. W., Mfg. Co., Mansfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Oster Manufacturing, Cleveland, O.
Pratt & Whitney Co., West Hartford, Conn.

STONES, OIL OR SHARPENING

Carborundum Co., Niagara Falls, N. Y.

STOOLS

Standard Pressed Steel Co., Jenkintown, Pa.

STRAIGHT EDGES

Johansson Div., Ford Motor Co., Dearborn, Mch.
Jones Machine Tool Works, Inc., Philadelphia, Pa.
Starrett, L. S., C., Athol, Mass.

STRAIGHTENING MACHINERY

Baldwin-Southwark Corp., Philadelphia, Pa.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.
Watson-Stillman Co., Roselle, N. J.

STUD SETTERS

Errington Mechanical Laboratory, 200 Broadway, New York.
Modern Tool Wks., Rochester, N. Y.
Procunier Safety Chuck Co., 18 S. Clinton St., Chicago.

SUB PRESSES

Baumbach, E. A., Mfg. Co., 1810 S. Kilbourn Ave., Chicago.
U. S. Tool Company, Inc., Ampere, N. J.
Waltham Mch. Wks., Waltham, Mass.

SUPERFINISHING MACHINES

International Machine Tool Corp. (Foster Div.), Elkhart, Ind.
Norton Co., Worcester, Mass.

SWAGING MACHINES

Cincinnati Shaper Co., Cincinnati, O.
Etna Machine Co., Toledo, O.
Langelier Mfg. Co., Providence.
Torrington Co., Torrington, Conn.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

SWITCHES

Allen-Bradley Co., Milwaukee, Wis.
General Electic Co., Schenectady, N. Y.
National Acme Co., Cleveland.
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

TACHOMETERS

Leeds & Northrup Co., Philadelphia.
Veeder-Root Inc., Hartford, Conn.

TAPER PINS, STANDARD

Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., West Hartford, Conn.

TAP EXTENSIONS

Allen Mfg. Co., Hartford, Conn.

TAP HOLDERS

Errington Mechanical Laboratory, 200 Broadway, New York.
Gairing Tool Co., Detroit.
McCrosky Tool Corp., Meadville, Pa.
Procunier Safety Chuck Co., 18 S. Clinton St., Chicago.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago.

TAPPING ATTACHMENTS AND DEVICES

Avey Drilling Mch. Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence.
Errington Mechanical Laboratory, 200 Broadway, New York.
Ettco Tool Co., Brooklyn, N. Y.
Haskins, R. G., Co., 617 So. California Ave., Chicago.
Leland-Gifford Co., Worcester, Mass.
McCrosky Tool Corp., Meadville, Pa.
Modern Tool Wks., Rochester, N. Y.
Procunier Safety Chuck Co., 18 S. Clinton St., Chicago.

TAPPING MACHINES

Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.
Avey Drilling Mch. Co., Cincinnati, O.
Bakewell Mfg. Co., Los Angeles, Cal.
Barnes Drill Co., Rockford, Ill.
Barnes, W. F., & John, Co., Rockford, Ill.
Baush Machine Tool Co., Springfield, Mass.
Bradford Machine Tool Co., Cincinnati, O.
Elgin Tool Wks., Inc., Berteau & Ravenswood Ave., Chicago.
Frew Machine Co., Philadelphia.
Geometric Tool Co., New Haven, Conn.
Greenlee Bros. & Co., Rockford, Ill.
Haskins, R. G., Co., 617 So. California Ave., Chicago.
Kingsbury Mch. Tool Corp., Keene, N. H.
Langelier Mfg. Co., Providence
Leland-Gifford Co., Worcester, Mass.
Modern Tool Wks., Rochester, N. Y.
Moline Tool Co., Moline, Ill.
Murchey Mch. & Tool Co., Detroit.
National Acme Co., Cleveland.
Procunier Safety Chuck Co., 18 S. Clinton St., Chicago.
Rickert-Shafer Co., Erie, Pa.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

TAPS

Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Butterfield Div. Union Twist Drill Co., Derby Line, Vt.
Card, S. W., Mfg. Co., Mansfield, Mass.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Mch. Co., Hartford, Conn.
Landis Mch. Co., Waynesboro, Pa.

Morse Twist Drill & Mch. Co., New Bedford, Mass.
Murchey Mch. & Tool Co., Detroit.
National Acme Co., Cleveland.
Pratt & Whitney Co., West Hartford, Conn.
Winter Bros. Co., Wrentham, Mass.

TAPS, COLLAPSING
Geometric Tool Co., New Haven, Conn.
Landis Mch. Co., Inc., Waynesboro, Pa.
Modern Tool Wks., Rochester, N. Y.
Murchey Mch. & Tool Co., Detroit.
National Acme Co., Cleveland.
Rickert-Shafer Co., Erie, Pa.

THERMOMETERS, INDICATING AND RECORDING
Leeds & Northrup Co., Philadelphia, Pa.

THREAD CUTTING MACHINERY
Brown & Sharpe Mfg. Co., Providence.
Eastern Machine Screw Corp., New Haven, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Geometric Tool Co., New Haven, Conn.
Grant Mfg. & Mch. Co., Bridgeport, Conn.
Landis Mch. Co., Inc., Waynesboro, Pa.
Lees-Bradner Co., Cleveland.
Modern Tool Wks., Rochester, N. Y.
Oster Manufacturing, Cleveland, O.
Murchey Mch. & Tool Co., Detroit.
Pratt & Whitney Co., West Hartford, Conn.
Rivett Lathe & Grinder, Inc., Brighton, Boston.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

THREAD CUTTING TOOLS
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago.
Eastern Machine Screw Corp., New Haven, Conn.
Geometric Tool Co., New Haven, Conn.
Landis Mch. Co., Inc., Waynesboro, Pa.
Modern Tool Wks., Rochester, N. Y.
Oster Manufacturing, Cleveland, O.
Pratt & Whitney Co., West Hartford, Conn.
Ready Tool Co., Bridgeport, Conn.
Rivett Lathe & Grinder, Inc., Brighton, Boston.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

THREAD GAGES
See Gages, Thread.

THREAD GRINDING MACHINES
See Grinding Machines, Thread.

THREAD MILLING MACHINES
Hanson-Whitney Mch. Co., Hartford, Conn.
Lees-Bradner Co., Cleveland.
Pratt & Whitney Co., West Hartford, Conn.
Waltham Mch. Wks., Waltham, Mass.

THREAD ROLLING MACHINES
V & O Press Co., Hudson, N. Y.
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

TIN AND TERNE PLATES
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp. (U. S. Steel Corp. Div.), Pittsburgh.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.

TOOL BITS, HIGH SPEED STEEL
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago.
Barber-Colman Co., Rockford, Ill.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
Jessop Steel Co., Washington, Pa.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

TOOL BITS, SPECIAL ALLOY
Haynes Stellite Co., Kokomo, Ind.

TOOL GRINDERS
See Grinders for Sharpening Turning and Planing Tools

TOOL HEADS, ADJUSTABLE
Gairing Tool Co., Detroit.

TOOL HOLDERS
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago.
Cleveland Twist Drill Co., Cleveland.
Gairing Tool Co., Detroit.
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
Lovejoy Tool Co., Inc., Springfield, Vt.
R and L Tools, Nicetown, Philadelphia.
Ready Tool Co., Bridgeport, Conn.
Scully-Jones & Co., 1903 S. Rockwell St., Chicago. (Turret)
Warner & Swasey Co., Cleveland.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

TOOLMAKERS' INSTRUMENTS
Brown & Sharpe Mfg. Co., Providence.
Starrett, L. S., Co., Athol, Mass.

TOOL STEEL
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co. of America, Chrysler Bldg., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Jessop Steel Co., Washington, Pa.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

TOOLS, CARBIDE-TIPPED
Carboloy Co., Inc., Detroit.
Ex-Cell-O Corporation, Detroit.
Firth-Sterling Steel Co., McKeesport, Pa.
Gairing Tool Co., Detroit.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
McKenna Metal Co., Latrobe, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Vanadium Alloys Steel Co., Latrobe, Pa.
Vascoloy-Ramet Corp., No. Chicago, Ill.

TOOLS, LATHE, SHAPER AND PLANER
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago.
Firth-Sterling Steel Co., McKeesport, Pa.
Gisholt Machine Co., Madison, Wis. (For Lathes Only).
Haynes Stellite Co., Kokomo, Ind.
Illinois Tool Wks., 2501 N. Keeler Ave., Chicago.
Jones & Lamson Mch. Co., Springfield, Vt.
McKenna Metals Co., Latrobe, Pa.
Ready Tool Co., Bridgeport, Conn.
Warner & Swasey Co., Cleveland.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

TRANSFORMERS
General Electric Co., Schenectady, N. Y.
Wagner Electric Co., St. Louis, Mo.

TRANSMISSION MACHINERY
See Hangers, Shafting, Pulleys, Clutches, Couplings, Belting, Chains, etc.

TRANSMISSION, VARIABLE SPEED
Continental Machines, Inc., Minneapolis, Minn.
Reeves Pulley Co., Columbus, Ind.
Toledo Timer Co., Toledo, O.

TUBE FLANGING MACHINES
Grant Mfg. & Mch. Co., Bridgeport, Conn.

TUBE MACHINERY, FORMING AND DRAWING
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

TUBING, STAINLESS STEEL
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Carpenter Steel Co., Reading, Pa.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.

TUBING, STEEL AND SEAMLESS STEEL
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
National Tube Co. (U. S. Steel Corp. Div.), Pittsburgh.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.
Timken Roller Bearing Co., Canton, O.

TUMBLING BARRELS
See Barrels, Burnishing and Tumbling.

TUNGSTEN CARBIDE
Carboloy Co., Inc., Detroit.
Firth-Sterling Steel Co., McKeesport, Pa.
McKenna Metals Co., Latrobe, Pa.

TWIST DRILLS
See Drills, Twist.

UNIVERSAL JOINTS
Baush Machine Tool Co., Springfield, Mass.
Boston Gear Works, Inc., No. Quincy, Mass.

VALVES, HYDRAULIC
Baldwin-Southwark Corp., Philadelphia, Pa.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
Racine Tool & Mch. Co., Racine, Wis.
Sundstrand Machine Tool Co., Rockford, Ill.
Watson-Stillman Co., Roselle, N. J.

VALVES, PNEUMATIC
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.

VISES, BENCH
Avey Drilling Mch. Co., Cincinnati, O.
Desmond-Stephan Mfg. Co., Urbana, O.

VISES, MACHINE
Armstrong-Blum Mfg. Co., 5743 Bloomingdale Ave., Chicago.
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago.
Avey Drilling Mch. Co., Cincinnati, O.
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence.
Covel Mfg. Co., Benton Harbor, Mich.
Desmond-Stephan Mfg. Co., Urbana, O.
Graham Mfg. Co., Inc., E. Greenwich, R. I.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago.
LeBlond, R. K., Mch. Tool Co., Cincinnati.
Sheldon Machine Co., 1627 N. Kilbourn Ave., Chicago, Ill.

VISES, PIPE
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

VISES, PLANER AND SHAPER
Cincinnati Planer Co., Cincinnati.
Cincinnati Shaper Co., Cincinnati.
Graham Mfg. Co., Inc., E. Greenwich, R. I.

VOLTMETERS
General Electric Co., Schenectady, N. Y.

WASHERS
Boston Gear Works Inc., No. Quincy, Mass.
Shakeproof Lock Washer Co., 2553 N. Keeler Ave., Chicago, Ill.

WELDING AND CUTTING EQUIPMENT, OXY-ACETYLENE
Air Reduction Sales Co., 60 E. 42nd St., New York.
Linde Air Products Co., 30 E. 42nd St., New York.

WELDING AND CUTTING GASES
Air Reduction Sales Co., 60 E. 42nd St., New York.
Linde Air Products Co., 30 E. 42nd St., New York.

WELDING EQUIPMENT, CONTROLS FOR ELECTRIC
General Electric Co., Schenectady, N. Y.

WELDING EQUIPMENT, ELECTRIC ARC
Air Reduction Sales Co., 60 E. 42nd St., New York.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

WELDING EQUIPMENT, ELECTRIC, SPOT, BUTT, SEAM, ETC.
Federal Mch. & Welder Co., Warren, O.

WELDING POSITIONER
Cullen-Friestedt Co., 1305 So. Kilbourn Ace., Chicago.

WIRE
American Steel & Wire Co. (U. S. Steel Corp. Div.), Pittsburgh.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co. (U. S. Steel Corp., Div.), San Francisco.
Tennessee Coal, Iron & R. R. Co. (U. S. Steel Corp. Div.), Birmingham, Ala.

WIRE DRAWING MACHINERY
Waterbury Farrel Fdry. & Mch. Co., Waterbury, Ct.

WIRE FORMING MACHINERY
Baird Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., Ampere, N. J.

WIRE NAIL MACHINERY
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago.

WIRE ROPE
American Steel & Wire Co. (U. S. Steel Corp. Div.), Cleveland.
Columbia Steel Co. (U. S. Steel Corp. Div.), San Francisco, Cal.

WORM DRIVES
Cleveland Worm & Gear Co., Cleveland.
Philadelphia Gear Works, Philadelphia, Pa.

WRENCHES
Armstrong Brothers Tool Co., 313 N. Francisco Ave., Chicago
Greene, Tweed & Co., Bronx Blvd. & 238th St., New York.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

WRENCHES, DETACHABLE SOCKET
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

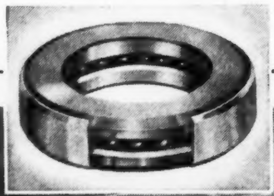
WRENCHES, PIPE
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

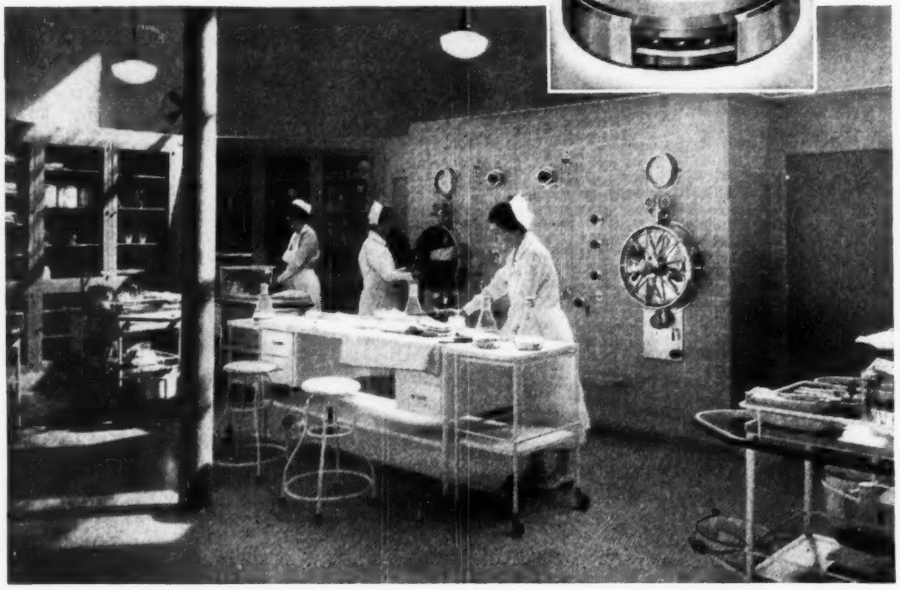
WRENCHES, RATCHET
Greene, Tweed & Co., Bronx Blvd. & 238th St., New York.
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

WRENCHES, TAP
Besly, Chas. H., & Co., 120-B N. Clinton St., Chicago.
Butterfield Div. Union Twist Drill Co., Derby Line, Vt.
Card, S. W., Mfg. Co., Mansfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., West Hartford, Conn.

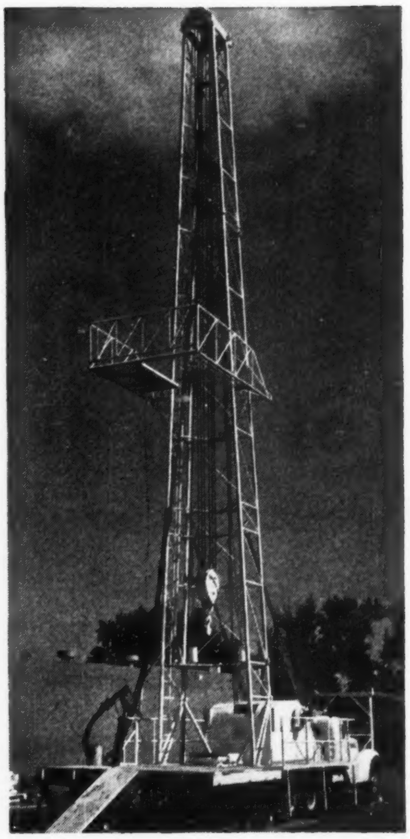
WRENCHES, TORQUE MEASURING
Williams, J. H., & Co., 225 Lafayette St., New York, N. Y.

IN THE NEWS
WITH BANTAM BEARINGS



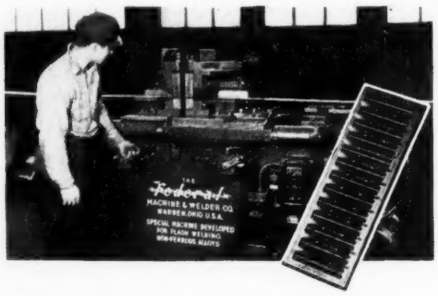


SAFETY IN SURGERY took a long stride forward when American Sterilizer Company originated the temperature-control technique for effective sterilization of instruments and supplies. These precision instruments, shown above in the Hospital of the University of Pennsylvania, embody the most modern principles in engineering design. A feature is the use of Bantam Ball Thrust Bearings in the door-locking mechanism to facilitate easy operation.

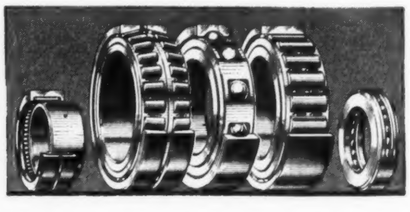


THE QUEST FOR OIL BECOMES SIMPLER as progressive manufacturers develop new equipment designed for economical prospecting. Outstanding example is George E. Failing Supply Company's new "66" portable slim hole drilling rig, equipped with Bantam Quill Bearings in crown and traveling blocks, to give efficient operation.

GIANT BEARINGS in single, double and four-row types up to 51" O.D., designed and built by Bantam for the steel industry, have made outstanding performance records. Both work rolls and back-up rolls of the continuous hot strip mill shown above are Bantam equipped for long life and successful performance in severe service.



MASSES OF METAL roll back and forth 200 times an hour in this high-speed production welding unit built by The Federal Machine and Welder Company—roll smoothly and efficiently on special ladder-type bearings designed by Bantam. Bearings of this type find many applications where friction in reciprocating motion must be kept to a minimum.



EVERY MAJOR TYPE of anti-friction bearing is included in Bantam's line—straight roller, tapered roller, needle, and ball. Bantam serves every industry with a wide range of standard bearings that meet many normal requirements. Bantam engineers offer unbiased advice on selection of standard bearings—and design custom-built bearings in large sizes or special types for unusual conditions. If you have an exceptionally difficult bearing problem, TURN TO BANTAM.

BANTAM BEARINGS

STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL

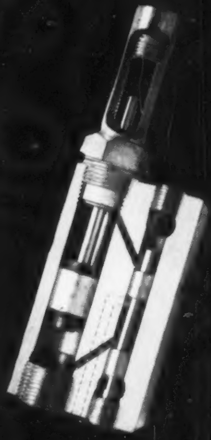
BANTAM BEARINGS CORPORATION • SOUTH BEND • INDIANA

ALPHABETICAL INDEX OF ADVERTISERS

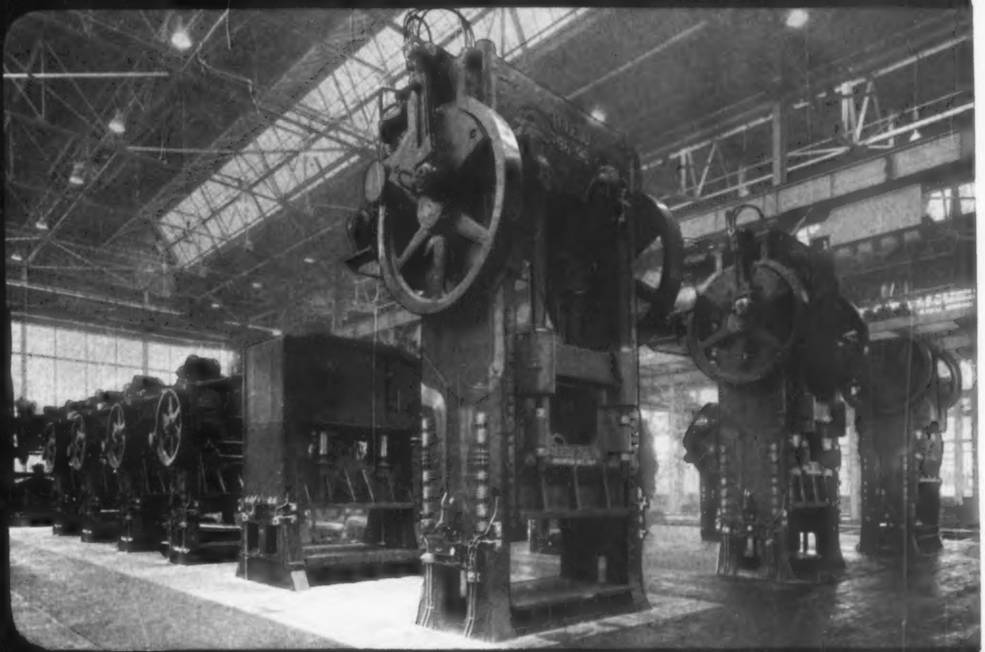
ALPHABETICAL INDEX OF ADVERTISERS—Continued

Classified and Re-Sale Section

You see



BUT



Farval "sees"

You must protect those bearings if you are to maintain peak production.

You can see your machines but Farval "sees" the bearings inside the machines—whether 10 or 10,000. Furthermore, Farval sees *to* it that every bearing is properly lubricated — and with a tell-tale indicator to show the job is done.

Positive lubrication of *all* your machines by Farval Centralized Systems will maintain peak production by eliminating shutdowns due to dry bearings. Farval will also reduce power consumption as much as 30%—increase life of bearings up to 10 times—lower maintenance cost by 75%—and prolong the life of your equipment indefinitely.

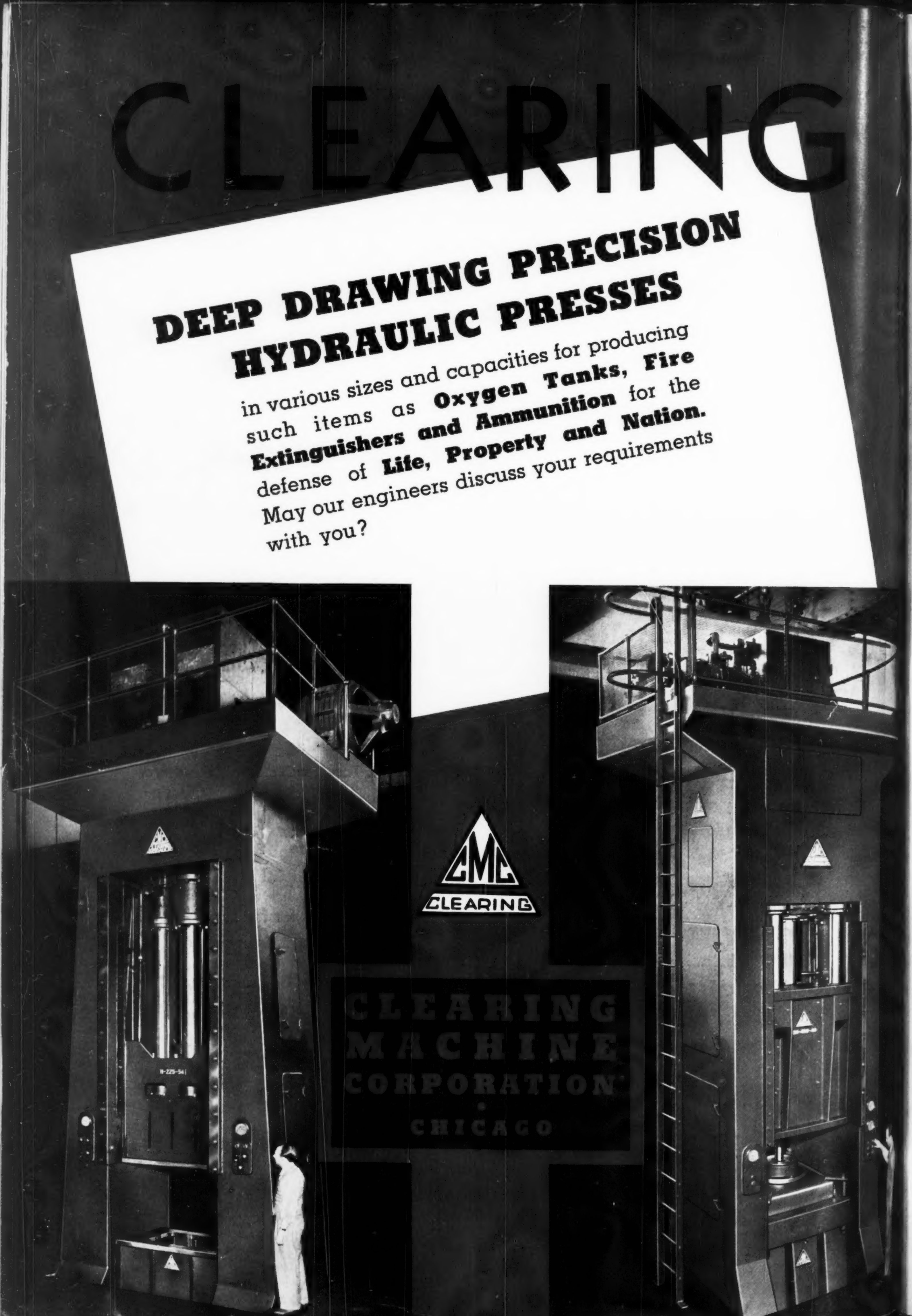
Special Delivery
TO EVERY BEARING

Hadn't *you* better see a Farval Representative right away?

The Farval Corporation, 3276 East 80th Street, Cleveland, Ohio.

Affiliate: The Cleveland Worm & Gear Company, Manufacturers of Automotive and Industrial Worm Gearing
In Canada: PEACOCK BROTHERS LIMITED

FARVAL


CLEARING
DEEP DRAWING PRECISION
HYDRAULIC PRESSES
in various sizes and capacities for producing such items as **Oxygen Tanks, Fire Extinguishers and Ammunition** for the defense of **Life, Property and Nation.** May our engineers discuss your requirements with you?
CMC
CLEARING
CLEARING
MACHINE
CORPORATION
CHICAGO